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Universal Face and Angle Grinder.

The illustration on this page represents a new machine just brought out by the Diamond Machine Co. of Providence, R. I.

This machine is intended to do a large variety of grinding where but a small amount of stock is to be removed, and a true flat surface is required. It is claimed by the makers to be particularly adapted to the performance of a large part of the light work usually done upon a planer or milling machine, doing the work more quickly and leaving a better surface where the work comes within the capacity of the machine.

The pieces to be ground are held in fixtures fastened to the platen, or clamped to the platen itself. The table or platen is adjustable to any degree, and is furnished with a graduated index finger, enabling the operator to set and reset it upon the same angle, to grind bevel surfaces alike and true.

It has a graduated base which swivels upon a central pivot, and which can be turned at any angle. The head carries an annular or cup wheel on one end, twelve inches in diameter.

Vertical Drills—Their Construction and Uses.

BY JOHN J. GRANT.

Another unexplainable thing about a machine shop is the limited number of suspension drills in use. A suspension drill, if rightly designed and constructed, is one of the most labor saving tools that can possibly be put into the shop.

It has repeatedly been shown that many a good idea, or tool, has been spoiled by bad designing or construction, causing the idea to be abandoned. This has certainly been the case in most suspension drills that have come under my notice. As generally made they are a botch, usually consisting of a small frame of either wood or iron—generally the former—bolted to the timbers or floor with a spindle having no lateral adjustment in either direction, the raising of the spindle being accomplished by means of a chain over a sprocket wheel or sheave. As a general thing the spindle is about as plumb as the average lamp-post, and no adjustment for the drill head, making it necessary to have the spindle, in some cases, three or four feet below the bearing, and yet, with all its defects, in shops where they have such as these even, the workmen will often use them in preference to the radial or other styles of drills. One of the principal reasons for this is the unobstructed clear space in every direction below the drill spindle, thus allowing the workman free access to every part of the piece being drilled.

The requirements of a good suspension drill are as follows:

Spindle adjustable over a large area of surface, to enable work of large dimensions to be drilled with one setting. Spindle adjustable vertically, so that work of great height can be drilled. Ease of manipulation; all feeds and adjustments being worked from the floor. Large index dial for depth of holes, so that it can be seen from the floor. Automatic stop motion to feed; and last, but certainly not least, plenty of power. A tool of this description, well designed and built, would prove a boon to any shop doing engine or mill work.

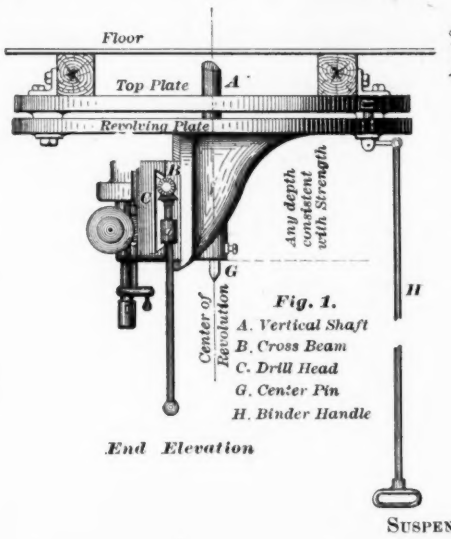


Fig. 1.
A. Vertical Shaft
B. Cross Beam
C. Drill Head
G. Center Pin
H. Binder Handle

End Elevation

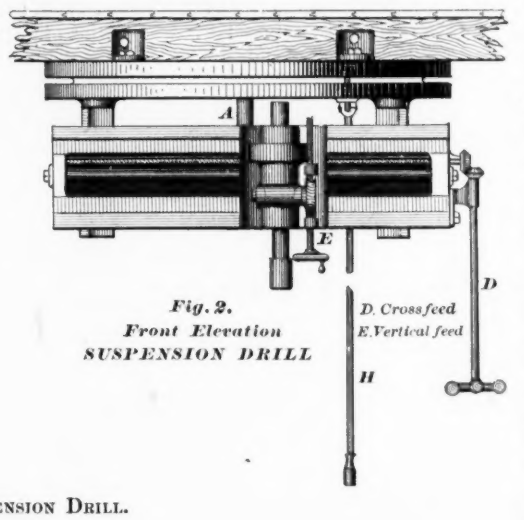
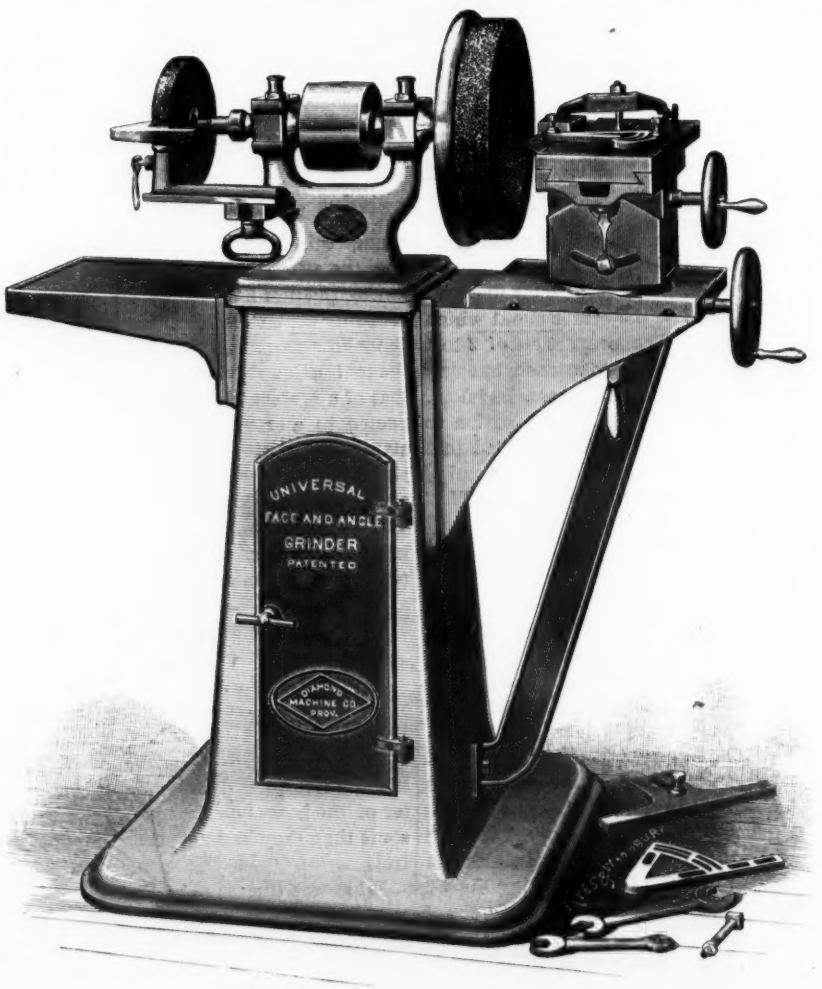


Fig. 2.
Front Elevation
SUSPENSION DRILL

D. Cross feed
E. Vertical feed

SUSPENSION DRILL.

A drill, constructed as shown in Fig. 1, has many advantages over the radial drill, amongst which are vertical accuracy of the spindle at any point on the cross beam, a small shop, one having a radius of about 4 feet would be extremely handy for the general run of machine work. As shown in Fig. 1, the framework of the drill is made circular in form, and in two parts. The upper part is bolted to the floor or timbers overhead, and has a turned track, to allow the revolving plate or spider that carries the drill arm, or beam, to make a complete revolution. This is clamped rigid to the



UNIVERSAL FACE AND ANGLE GRINDER.

clear space in every direction under the drill spindle, and greater range for work, both in length and circumferentially. There is, of course, no limit, except shop room, to the size such a drill can be made, but in upper piece, when at work, by the rod shown at *H*.

Through the center of the spider the driving shaft is carried and connected by bevel gearing above, to a horizontal shaft having a suitable cone pulley and gearing. In shops that are light studded, the revolving plate should be fitted with drop slides, braced back against the circular plate.

The beam carrying the drill head is gibbed to the drop slides and raised and lowered either by hand or power, and can be used for deep drilling. The power is transmitted to the drill spindle by two horizontal shafts, one in the arm, in the same manner as the radial drill, the other placed at the back side of the beam and parallel with the inside shaft, geared to the upright shaft by bevel gears, and at the end of the beam, by spur gearing to the shaft inside the arm, in the same manner as the back gearing of an engine lathe. The drill head may be of the same pattern as the regular radial drill. This arrangement allows the drill arm or beam to revolve around the driving shaft and the drill head to swivel, so making it a perfectly universal drill for any angle. Dowel pins in both adjustments, when in their normal position, bring the spindle perfectly true for regular work.

The spindle for a suspension drill should be of extra length, to allow of drilling holes at different heights without resetting the beam.

The floor under a suspension drill for a radius of about 8 feet should be as level as possible, and if made of cast-iron with T slots for the purpose of bolting work down it would be much better. This style of drill is hardly complete without a table, as described in a previous article on drills. It should be about 3 feet high, and would be still better if one side were planed true, and fitted with T slots to bolt wide, thin pieces against, for the purpose of drilling the edge.

One of the great advantages of the suspension drill, when properly constructed, is the large area over which the drill head can be traversed without the disadvantages of the radial drill, which has two bad faults, namely, the upward spring of the arm when the drill head is at its furthest position from the column, and not being able to make an entire revolution around the column, except in a few makes of radial drills, and when so constructed, they are very faulty, as the column is then no larger at the base than at its top.

Another great advantage of a suspension drill made as described, is that a circle of holes can be drilled, with a drill of the size named, from about 12 inches to 7 feet in diameter, and to radiate from any center which can be found, with the piece marked *G*, which is directly in the center of the drill frame. The above arrangement is very useful in steam engine work where many cylinder heads are drilled; also for large valves, pipe, and work of a similar class.

Dr. Helwig on Immigration.

In an address delivered before an audience of workingmen at Springfield, Ohio, recently, on the subject of "How Can the Wages of the American Workman be Increased?" Rev. Dr. Helwig, ex-President of Wittenberg College, enumerated, among other causes which tend to reduce wages, the competition forced upon American

workmen by unrestricted immigration, declaring that the "burning question with American workmen is to be found in connection with foreign emigration to this country," and that "there is certainly no consistency in putting a tariff on the manufactures of other countries and then freely importing the men that make them and putting them side by side with the American laborer."

It has long been pointed out, by the advocates of free trade, that there was an inconsistency in the course of the American government in this respect; but Dr. Helwig, as we happen to know, is not a free trader, but a protectionist, and the fact that such men, of undoubted sincerity and ability, are being led by the logic of events to the expression of such sentiments is of considerable significance, without regard to whether we choose to agree or disagree with them.

Quick Return Motions.

By Prof. A. T. Woods.

By the term "quick return motion" is meant the mechanism by means of which the back stroke of a sliding piece is made in less time than the forward stroke. The most common applications of such motions are to planers and shapers. In the former the quick return is generally accomplished by the use of driving pulleys of different sizes for the forward and back strokes, or by means of intermediate gearing. In the latter, some form of slotted crank is frequently used, and it is this form which we propose to investigate.

Fig. 1 illustrates the simplest form of the slotted crank motion. $P\ B$ is the driving crank which revolves at a uniform speed about the center B, and carries a pin P, which slides in a slot in the arm $C\ P\ A$. This slotted arm swings about the fixed center A as the pin P slides up and down in the slot during the revolution of $P\ B$. Supposing this mechanism to be part of a shaper, the sliding head which carries the cutting tool would be driven by means of a short connecting rod from C. An examination of the figure will make it clear that when the crank $P\ B$ is at right angles to the center line of the slot, as at $P\ B$ and $P'\ B$, the slotted arm can be moved no further, and that the distance $C\ C'$ is therefore the travel or length of stroke of the sliding head and cutting tool. Supposing $C\ C'$ to be the forward or cutting stroke, and that the crank revolves in the direction shown by the arrow, it will be seen that the pin P moves through the arc of a circle $P\ E\ P'$, while the tool moves from C to C', and that P moves through the arc $P'\ D\ P$, while the tool moves back from C' to C. Therefore, if, as we have assumed, the crank $P\ B$ revolves at a uniform speed, we may represent the time of the forward stroke by the length of the arc $P\ E\ P'$, and that of the back stroke by the length of $P'\ D\ P$. In the figure, $P\ E\ P'$ is $\frac{2}{3}$ of the circumference, and $P'\ D\ P$ is $\frac{1}{3}$ of the circumference, and therefore the back stroke will be made in one-half the time of the forward stroke. Or, to illustrate still further, if the crank $P\ B$ makes a revolution in 3 seconds, or 20 revolutions per minute, the time of the forward stroke will be 2 seconds, and that of the back stroke 1 second.

We will now consider the effects of changing the proportion of the parts in Fig. 1. If the crank $P\ B$ be shortened to $p\ B$ for example, it is clear that the travel of the tool will be reduced to $c\ c'$. Also that the angle $p\ d\ p'$, through which the crank $p\ B$ moves during the back stroke, is greater than the angle $P\ D\ P'$, and therefore the back stroke will take more time than before. And, as the angle $p\ e\ p'$ is less than $P\ E\ P'$, the forward stroke will take less time. Thus, by shortening the crank $P\ B$, the times of the two strokes are made more nearly equal, or the quick return is less marked. It will be seen that a similar effect will be produced by lowering the center A and leaving the crank $P\ B$ as at first.

Now suppose the center A to be raised until it is inside the point D, or between B and D. We will then have an arrangement like Fig. 2, which is lettered similarly to Fig. 1. Suppose the crank $P\ B$ to revolve exactly as before, the slotted arm $A\ C$ will now make complete revolutions, instead of swinging back and forth, as in Fig. 1. The sliding head will now be driven in the direction $A\ H$, by means of a connecting rod from C, and the ends of the strokes will occur when $A\ C$ is on the dead centers c and c' and the pin P at p and p'. During the forward stroke, P moves through the arc $p\ E\ p'$, and during the back stroke through $p'\ D\ p$, so that the lengths of these arcs will represent the time required for each stroke, exactly as before.

In Fig. 2 these arcs are of the same lengths as $P\ E\ P'$ and $P'\ D\ P$ in Fig. 1, and hence the back stroke is made in half of the time of the forward stroke.

To lay out such a motion as this, we first divide the circle in which P moves into 3 equal parts, beginning at E on the diameter which passes through A and B. E, p' and p are the three points of division. Then draw a line through p at right angles to $A\ B$. This will be the center line of motion of the wrist pin or the end of the connecting rod which is attached to the sliding head, and the point A where this center line cuts the line $E\ B$ will be the center about which $A\ C$ is to turn. The proportion of 2 to 1 has been assumed for convenience, but any other proportion can, of course, be taken. For example: if we wish the proportion to be as 5 to 3, the circle must be divided into $5 + 3 = 8$ equal parts and the points p and p' located so that $p\ D\ p' = 3$ parts and $p\ E\ p' = 5$ parts.

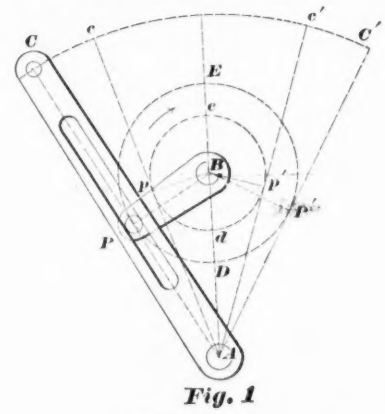


Fig. 1

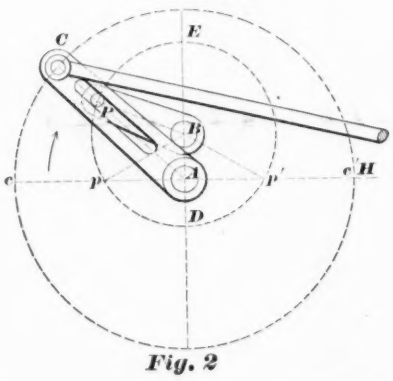


Fig. 2

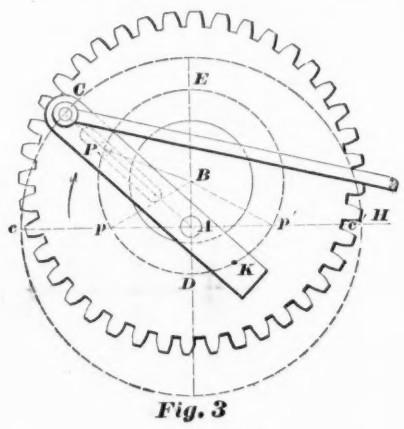


Fig. 3

Fig. 4

Quick Return Motions.

It is evident that the arrangement shown in Fig. 2 is not a practical construction, as the parts would conflict. Fig. 3 illustrates the practical form of the same motion, and in this shape it is familiar as the Whitworth quick return motion. The letters represent the same parts as in Fig. 2. The spur gear shown is a plate wheel driven by a pinion, not shown, and turns about a large fixed journal shown by the full line circle. The arm $A\ C$ turns about a pin A set in the end of this journal or shaft. The pin P is fixed in the face of the plate wheel and slides in a slot in the arm $A\ C$. By comparing Figs. 2 and 3 it will be clear that the principle of the motions is exactly the same, and referring to Fig. 1 we find the same principle, viz., the unequal arcs passed over by the driving pin during the forward and back stroke of the sliding head. A variation in the construction of the Whitworth motion can be made by placing the pin P at K and slotting that end of the arm $A\ C$ so that B will be between C and P, instead of being on one side, as in Fig. 3. When this change is made, the pin P or K must be revolved in the opposite direction to that shown by the arrow, supposing the tool to be to the right of the figure, as before.

It would seem at first sight that such arrangements as these would produce a rapidly changing speed of the cutting tool, which would make them undesirable for shaping machines, but investigation will show that the speed is remarkably uniform throughout the greater part of the stroke. To illustrate this, in Fig. 4, let $A\ B$ represent the length of the arc $P\ E\ P'$, or the distance through which P moves during the forward stroke. Divide this into, say, 8 equal parts, which, as P revolves at a constant speed, will represent equal intervals of time, and at the middle of each division draw lines perpendicular to $A\ B$. On these lines lay off the distance traveled by the tool during each eighth of the arc as found from a drawing. Then a curve drawn through points found in this way will be shaped like that shown by a full line. If the speed of the tool was the same at all parts of the stroke, the curve would be a straight line parallel to $A\ B$, and the difference between it and a straight line will represent graphically how much variation there is in the actual speed. It is evident that for the greater part of the stroke the curve is nearly parallel to $A\ B$, and therefore that the speed of the tool is nearly constant during the time that it is cutting.

The curve shown by dashes represents in the same way the motion derived from the simple crank, the effect of the connecting rod being neglected. A short rod would change this curve to that shown by a dotted line, the effect being to decrease the speed during the first half stroke and to increase it during the last half. These curves clearly show how much more uniform the speed of the tool in these quick return motions is than that of a crosshead or piston as usually connected to a crank which revolves at a constant speed. The connecting rod produces similar effects in the quick return motions, and is more marked in the forms of Figs. 2 and 3 than in that of Fig. 1, but with ordinary proportions it is not sufficient to be readily shown on a figure of this size.

Shop Notes.

By Jarno.

No. 5.

The shaft holes did not come in the center of the bosses on the machine beds. For some time they had not been coming central.

What was the cause? Probably the patterns had become warped. Upon examination they were found to be right. Perhaps the trouble was in the foundry. A careful search in the foundry failed to bring to light the cause of the trouble.

As is usual with such work, the holes were made at given distances from the planed surfaces. The holes always came out of center in the same direction. As no cause for the trouble could be found, it was hoped that the next beds would come better. Instead of getting less, the trouble grew larger.

Then the work of the planer was examined. It was noticed that a heavier chip was taken from one edge than from the other edge. Why was this?

The planer man adjusted the beds on the planer by his spirit level—I should have said by his spirit plumb. There was an empty space where the level bulb used to be. One day the bulb had a struggle with a few bolts and a monkey-wrench at the end of the table. The bulb was defeated; its spirit went out and did not return.

Some one suggested that a level be placed upon the planer table, well out of the way of the bolts and monkey-wrench. This was done. The trouble was found. In a distance of four feet the planer was one-eighth of an inch out of level. The crosshead, or slide, of the planer, was parallel to the table. Hence, when the sides of the work were plumb, the planing on the top of the bed would not be square with the sides.

This all took place with my acquaintance over the way. His name is Gascon. He makes planers. Gascon has taken pride in having his own planers on a solid foundation. He starts from the bottom to have things solid. His planers rest directly on masonry. But the masonry of one of his planers settled and the planer followed on after.

I think we shall sometime do away with the word "solid." I believe it was once applied to savings banks and such things. Planers are like banks — they must be watched to keep them solid. Perhaps no foundation of any tool in a machine shop is tried so hard as a planer foundation. In a large planer several tons' weight changes ends at each stroke.

Gascon declares that no planer of his shall ever again be out of level more than one one-hundredth of an inch in four feet. Whatever opinion I may have of Gascon's planer foundations, I have but one opinion of him—he is solid.

Reader, are the planers in your shop level?

Humors of the Strike.

There is, at this time of writing, a strike of the locomotive engineers on the C. B. & Q. railroad. It is not within our province to speak of the merits or demerits of this strike but the opinions it has evolved from the press are, in some instances, both interesting and amusing. It will be remembered that the Brotherhood of Locomotive Engineers, and Chief Arthur, have received unstinted praise from the press during the past five years. In this respect there has been a complete somersault since the strike began, and, in some instances, the efforts to get on the other side are decidedly ludicrous.

For example, the *Railway Review*, in an article mainly noticeable for the effort to show that but little skill or knowledge is required in locomotive engine running, has the following:

It is indeed difficult to enlist the sympathies of the public for any class of strikers who are striking for anything more than bread or for more than a sufficient interval between working hours to properly sustain life. When a given class of men are receiving living wages and are working under reasonably humane rules as to hours of labor, they may rest assured that "the public" will give them precious little encouragement in their quarrels with their employers.

Of course it is impossible to look upon such a statement from a serious standpoint, the bewildered writer forgetting, apparently, in his new-born zeal, that he was writing what no one could possibly sustain him in, and what the railroad corporation would be the first to repudiate. We imagine that when he saw this paragraph in cold type he felt anything but proud of his achievement. It is a case of too much zeal.

It is probable, however, that the *Evening Post* will always be able to keep at the head for solid ludicrousness in dealing with this strike. In a labored editorial it finally comes to the point as below:

"As sure as they [the locomotive engineers] are guilty of any such acts, the Ameri-

can people will make short work of them. If it be made clear that driving a locomotive renders a man liable to occasional attacks of anti-social mania, they will provide that the management of locomotives shall be taught in the public schools, as part of the technical education, so as to relieve the business world from the fear of these general strikes."

This is something more than argument or sentiment. It is a stroke of genius of which the writer will feel proud when it shall have made him famous. Fortunately, there is never any question as to the seriousness of the *Post's* editorials, so he will receive full credit. It is a great idea, apparently never thought out before, because, like all great things, it is extremely simple—when one understands it. We venture to say that not one locomotive engineer in the whole country ever thought what an easy matter it would be to teach boys in pinafores, at cross-road schoolhouses, to run locomotives, or how easy it would be in case of a strike to depopulate a few public schools and settle the case at once. Nasby never evolved anything better than this paragraph from the *Post's* best man. Like Colonel Scott's coon, locomotive engineers everywhere, will, without doubt, come down.

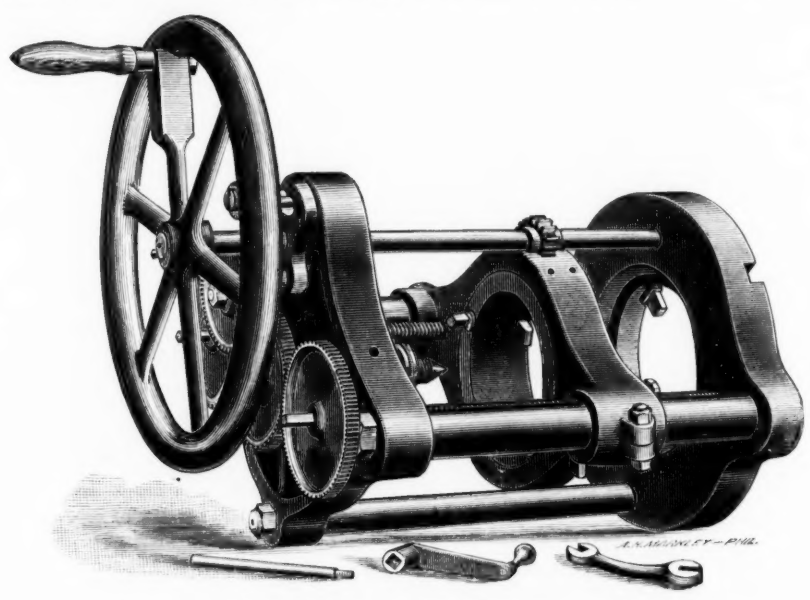
Improved Crank-Pin Machine.

The accompanying cut shows an improvement by Pedrick & Ayer, of Philadelphia, Pa., upon their well-known crank-pin turning machine.

The makers consider it a great improvement over their old one, retaining all its good points, and possessing others which make it a very valuable machine for its particular work. The tools are easy of access, can be seen, and are readily adjusted. All wear can be taken up. It is lighter in weight and much easier to handle, yet strong and powerful. It will quickly and accurately true up crank-pins, taking off that part of the pin which is eccentric only, and leaving the fillets at the corners. It will feed either way, and fit any size pin. It will go over the collar of a consolidated engine pin, and for very small pins is provided with a collar which is slipped into the circular cutter head and the tool fastened to it, so that it will not project far enough to spring.

The end of the machine next the driver contains a four-jawed scroll chuck, having thin jaws which center that end of the machine. At the opposite end there is a center which enters the center of the pin. The machine is then mounted true by the original centers, and is clamped in position by bolts passing through the spokes of the driver.

The annular cutter-head containing the tools is driven by a small pinion, hand-wheel and shaft. From this shaft by gearing an automatic feed is obtained either way, a smooth, even feed motion being imparted to the cutter head by means of two feed screws.



IMPROVED CRANK-PIN MACHINE.

Give the Belts Rest.

Most shop men are aware that it is better for belts to relieve the strain upon them whenever they are out of use, and it is a good practice to run belts off from lathe cones and in other places where it can be conveniently done every night when quitting work. Any one who has tried it, and observed its effects, knows that a leather belt so treated pulls better and lasts longer than if kept continually strained up. Of course it is by no means possible to treat all belts in that way, but whenever it is practicable the rule should be observed. A writer in *The Practical Engineer* (Manchester) says an experiment was made as follows: New leather belts, made from the same hides, were put onto two engine lathes which stood side by side, and were used upon the same kind of work. One of these was thrown off every night, while the other was never released. The latter had to be shortened four times during its existence, while the other was taken up but once, and was in good condition when the continuously strained one was worn out.

Of course a single experiment of that kind would not definitely settle such a matter, but all experience seems to point the same way.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

In a late paper, published in the AMERICAN MACHINIST, I endeavored to show the great importance of rigidity, tensile strength and moderate weight in marine engine bed plates and frames. Supposing that we should adopt the style of bed plate suggested in the paper referred to, viz , a cast-iron center structure, reinforced by steel or iron forgings, there are yet some features necessary to complete the design, that we have not considered at length in the previous writing.

The modern marine engine for merchant service is vertical, and arranged for screw propulsion. The steam cylinders vary in size, from 20 inches to 120 inches diameter, in stroke from 24 to 72 inches, and in number from two to six; and, as the high pressures in steam are developed from time to time, together with the introduction of the new styles of the twin screw system, we may soon expect to see as many as eight steam cylinders in our large and fast steamships.

These steam cylinders, with their jackets, receivers, steam chests and other necessary attachments, are necessarily very heavy, and they stand from 20 feet to 36 feet above the bottom flange of the main bed plate, or the top flange seat of the engine keelsons, according to the stroke. In order to provide for anything like rigidity, it is, therefore, necessary that we shall claim as much space as possible for the bed plate. Especially should the side sections, running fore and aft, be wide and well ribbed.

The engine keelsons are, of course, usually made largely of wrought-steel or iron plates, firmly riveted and stayed in position, while their width can be, and generally is, enough to offer an ample base surface for the side sections of the main bed plate. In building up a set of marine engine keelsons, I think it always advisable to introduce transverse castings, composed of the best charcoal iron, between the side stems of the girder combination, that will act as stiffeners to the stems and top plates. These cast-iron pieces should have holes cast in them in a transverse direction (that is to say, athwartships), large enough to allow several $1\frac{1}{4}$ in. rivets to pass entirely through them, and be riveted flush with the sides of the upright stem plates. In a medium sized iron or steel steamship, of modern construction, there is an abundance of room, vertically, for deep keelsons; so it will be seen that our cast-iron stiffeners can also be deep, and each can have at least six $1\frac{1}{4}$-inch rivets inserted in a central vertical line of their thickness, this thickness being, we will say, about 3 inches.

I believe in a system of wooden seatings, placed in the top cast-iron flanges of the keelsons and the top flanges of the main bed plate, in order to prevent the transmission of the shock and concussion always liable to be present in high-speed steam engines in marine service. These seatings should be taken from the heart of sound and well-seasoned yellow pine timber, and should be sectional, each piece being about 5 inches wide, $3\frac{3}{4}$ inches thick, and long enough to extend across the extreme width of each keelson casting. They should cover as much area of the top of the keelsons and bed plates as possible, after allowing for a separating lug or strip, between each wooden seat, of at least $2\frac{1}{4}$ in. The heavy reciprocating parts, and their high speeds, require something to soften the turning points during periods of severe racing, and when the marine governor fails to control the engines within the limits of a speed beyond the maximum. The more we accomplish in the prevention of shock, and the resultant crystallization of the details of construction, the better we can maintain the speed, and the life of the engines. In selecting the wooden seating pieces, care should be taken that they are thoroughly examined, and all sections with knots and long shrinkage cracks must be rejected. The strips should first be sawed to a width of 5 inches, and a thickness of $4\frac{1}{4}$ inches, then run through a surfacing planer to a uniform thickness of 4 inches, and finally dressed to $3\frac{3}{4}$ inches in thickness *after* they are driven firmly to their places in the keelsons and bed plate. After dressing in place, they should project upward from the top face of the keelsons and bed plate, about $\frac{5}{16}$ of an inch, this distance being reduced about $\frac{1}{32}$ of an inch, by screwing the nuts of the holding-down bolts to their positions.

As the seating pieces will be quite dry when they are driven home, they will immediately swell after the dripping of the oil from the engines reaches them, which it is bound to do after a day's running, for there will be small holes drilled directly over the wooden seats to ensure this result.

The charcoal iron stiffeners can be arranged to give a good body bearing to the main holding-down bolts, thus presenting a long section at the top and bottom of the keelsons and bed plate respectively, for reaming the bolt holes, and when the bolts are driven or pressed home, the keelson and bed plate become as one piece. Engine keelsons are frequently too light, and the writer knows of one instance where a set of keelsons were drawn and twisted badly, before the bed plate was half screwed down. Of course the bed plate was removed, and the keelsons reinforced by extra gusset and angle stays, and were at last made to "stand up to the work." The modern marine engine must be erected on *very* heavy wrought and cast metal combined keelsons, and no rolled or wrought-plate used in their construction should be less than $\frac{1}{2}$ inch thick. I am speaking now of vessels of 1,000 tons and upwards, and for a ship of 2,500 to 3,000 tons, the thinnest plate on the engine keelsons should not be less than $\frac{5}{8}$ of an inch thick, while the main stems should be from $\frac{3}{4}$ to $1\frac{1}{8}$ inch thick. Keelsons for both engines and boilers, coming as they generally do quite near midships, help very materially to strengthen the hull of the vessel, where it is naturally the weakest, and as long as rolled metals are as cheap as they are at present, I fail to see why anyone should build light engine keelsons.

The athwartship stays for the upright stems should be triangular in contour, extending from the stems as far as room will permit, and each stay should be reinforced at the bottom, by angle iron 6 feet by 6 inches, riveted with $\frac{7}{8}$ inch rivets, pitched 4 inches apart. Fore and aft, these stays should be placed every 24 inches, and their top edges should be strengthened with $3\frac{1}{2}$ inch by $3\frac{1}{2}$ inch heavy angle irons, riveted on with $\frac{7}{8}$ inch rivets.

There should be a deep keelson tie under each crank shaft bearing, which will connect the two side sections of the keelsons, each tie having a channeled piece of cast-iron, riveted to its top edges, the channel being the full width of the tie, minus the thickness of the two side plates. In each one of these channel spaces there should be placed a well-seasoned piece or pieces of sound yellow pine from 12 inches to 20 inches wide, according to the width of bearing casting or housing, and at least 10 inches thick or deep. It will readily be seen that *again* we are provided with wooden seatings, and these coming directly under the main bearings will relieve the main shaft, cranks, crank pins, connecting rods, cross head pins, and piston rods, of an enormous amount of shock, and consequent crystallization and final breakage.

In all cases the wooden seatings can be drawn out in case of splitting or rotting from any cause, and new ones inserted by simply relieving the load at that point by a hydraulic jack and driving out the old piece. With wood selected with even ordinary care, however, these seatings will last from fifteen to twenty-five years, without renewal, and when well selected they will last from thirty-five to fifty years, or almost an indefinite length of time.

It is not generally known that steel, when hardened, decreases in specific gravity, contracts in length and increases in diameter.—*The Engineer and Iron Trades Advertiser.*

True, it is not generally known, and for the very good reason that it is not true, but that, on the contrary, no one can tell, beforehand, what effect hardening will have upon the dimensions of a piece of steel. Sometimes it will be longer and sometimes shorter—sometimes larger in diameter and sometimes smaller in diameter. Nothing is "generally known" about it, except that not much of anything is known.

According to Mine Inspector McDonald's report of the second anthracite district for 1887, there were produced in that district 5,043,515 tons of anthracite. There occurred, during the year, 52 fatal and 146 non-fatal accidents, leaving 21 widows and 69 orphans. One employe was killed to every 261 employed, and one injured to every 93 employed.

In a machine for testing steel railway tires, in use in France, a succession of blows, similar to those delivered by means of a sledge hammer, are given to the tires, in place on their wheel centers and revolved on rollers.

And now England is being somewhat troubled by the importation of foreign cheap labor, and it is proposed to appoint a special select committee of Parliament to inquire into the subject.

In the nomenclature of mechanics nothing strikes an American mechanic as being more odd than the English use of the word "strap" for what we call a belt.

Practical Drawing.

By J. G. A. Meyer.

Forty-Sixth Paper.

Directions.—In the space marked 58 draw the vertical and horizontal projections of a cylinder with a prism passed through it, as shown in Figs. 298 and 299. The diameter of the cylinder is to be $4\frac{1}{2}$ inches, height $6\frac{1}{2}$ inches; prism is to be $2\frac{3}{4}$ inches square and 7 inches long. Use 3 inch scale. Find the lines of intersection and the development of the cylindrical surface.

417. *Remarks.* In our last paper it was stated that the length of a developed cylindrical surface should be determined by calculation, instead of obtaining this length, by setting the plain dividers to a distance equal to that from any one point of division in the circumference of the circle to the next point in the same circumference, and then with these dividers, stepping off a number of spaces on a straight line. The reason for this will be apparent in the following example.

Let it be required to find the development $a\ a_2$, Fig. 307, of the circumference $a\ b\ c\ d\ e\ f$ of a circle 2 feet in diameter.

We will first find the length of the line $a\ a_2$ by stepping off upon it, with the dividers a number of equal spaces, each one equal to a given division in the circumference. Divide the circumference into six equal parts, and let the points a, b, c, d, e, f, represent the points of division. Draw the horizontal line $a\ a_2$. Set the dividers to the distance from the point a to the point b, or from b to c, which amounts to the same thing, because all the spaces in the circumference are equal. Now, with these dividers, lay off in succession on the line $a\ a_2$, commencing from a, the points $b_2, c_2, d_2, e_2, f_2, a_2$, making the distance between the points a and b_2 equal to that between a and b on the circumference; $b_2\ c_2$ equal $b\ c$, and so on until six spaces have been laid off, and thereby obtaining the length of the line $a\ a_2$, which, according to this construction, is the development of the given circumference; measuring the line $a\ a_2$ we find it to be just 6 feet long.

If we now determine the length of the line $a\ a_2$ by calculation, that is, multiply the diameter by 3.1416, we have

2 feet × 3.1416 = 6.2832 feet;

showing that by the first method or construction line $a\ a_2$ is over 3 inches too short.

418. Now let us endeavor to find the cause for this difference.

If the length of the line $a\ a_2$ has been laid off correctly, and then wrapped around the circumference, the extremity a_2 of the line will just meet the other extremity a (of course, in these remarks we assume that the line $a\ a_2$ has no thickness), and one-sixth of the line $a\ a_2$, for instance the part from a to b_2, will cover-one sixth of the circumference, that is, the arc from a to b.

But now notice, in setting the dividers to a distance equal to that from a to b on the circumference, we really set the dividers to a length equal to that of the straight line $a\ b$, or the chord which joins the extremities of the arc, and since the length of this chord is less than the length of the arc, it follows that any one of these divisions $a\ b_2$ or $b_2\ c_2$ etc., on the straight line $a\ a_2$, which have been laid off with the dividers, will be equal to the length of a chord, and not to the length of the arc, as each division should be, and therefore the total length of the line $a\ a_2$ laid off in this manner, that is, with the dividers, will be too short.

We may obtain more accurate results by dividing the circumference into a greater number of equal parts, because by so doing we reduce the length of the arcs and the chords which join the extremities of the arcs; and since the smaller the arcs are made, the less will be the difference between the lengths of the arc and its chord, it follows that, by increasing the number of division in the circumference, the development will approach nearer to the true length, and may sometimes be sufficiently accurate for practical purposes. But generally the length of a development should be obtained by calculation.

Problem 58 A.

419.—To develop a given arc of a circle.

Fig. 308. Let $a\ b\ d$ be a given arc, described from the center c, with a radius $a\ c$ equal to 48 inches; the distance between the extremities a and d of the arc, measured in a straight line, is also equal to 48 inches, or in other words, the chord $a\ d$ is equal to 48 inches; it is required to develop the arc $a\ b\ d$; that is to say, it is required to find the length of the arc when straightened out.

For many practical purposes, it will be sufficiently accurate to divide the arc into a number of equal parts, each about one inch long, and then step off the same number and size of parts on the straight line $a_2\ d_2$; this line $a_2\ d_2$ will then be the development of the given arc.

The same remarks made in Art. 417 apply to this method of developing the arc, namely, in some cases it may not be sufficiently accurate. Hence, when greater accuracy is required, we must obtain the length of the arc by calculation.

420. Through the center b of the arc and the center c draw a straight line $b\ c$; this line $b\ c$ will be perpendicular to the chord $a\ d$, and will also divide the angle $a\ c\ d$ into two equal angles. The line $a\ r$, which is equal to one-half the chord $a\ d$, the line $r\ c$, and the radius $a\ c$, will form a right-angled triangle; the lengths of two sides of this triangle are known, namely, the length of the side $a\ c$ is equal to 48 inches, and the length of the side $a\ r$ is equal to 24 inches. Dividing the length of $a\ r$ by the length of $a\ c$, we obtain the ratio between the lengths of these sides, thus—24 inches ÷ 48 inches = .5, which shows that the side $a\ r$ is one-half as long as the side $a\ c$. The decimal .5 obtained by dividing the side $a\ r$ by the side $a\ c$ may be regarded as the sine. Looking in a table of natural sines (which may be found in any good engineer's pocket-book) for this sine or decimal .5, we find that the corresponding angle contains 30 degrees By construction the angle $a\ c\ r$ is equal to the angle $r\ c\ d$, and since angle $a\ c\ r$ contains 30 degrees, it follows that the angle double the size—that is, the angle $a\ c\ d$, must contain 60 degrees. Now, one degree is equal to $\frac{1}{360}$th part of the whole circumference $b\ l\ m\ n$, and therefore an arc containing 60 degrees of the same circle must be equal to $\frac{1}{6}$th of the whole circumference of that circle; hence we have the following proportion:

Three hundred and sixty degrees are to 60 degrees as the whole length of the circumference is to the length of the arc.

The number of inches in the circumference is obtained by multiplying the diameter of the circle by the constant number 3.1416, hence the circumference will contain 96× 3.1416=301.59 inches. Therefore to obtain the number of inches in the arc $a\ b\ d$ we have 360°: 60°: : 301.59″: length of arc; working out this proportion we have

$$\frac{60 \times 301.59}{360} = 50.26'' = \text{length of arc.}$$

In a similar manner we may obtain the length of any given arc.

421. It is important to remember that when the length of the arc $a\ b\ d$ is to be found by calculation, we must not take the line $a\ d$ to represent the sine of the arc $a\ b\ d$; because, a sine of an arc is represented by a line drawn from one extremity of the arc, prerpendicular to a diameter drawn through the other extremity of the arc. Thus: considering $a\ b$ to be a given arc, $a\ r$ is the sine of the arc $a\ b$, because $a\ r$ is a line drawn from the extremity a of the arc, perpendicular to the diameter $b\ m$ drawn through the other extremity b of the same arc.

Now, since the chord $a\ d$ is not perpendicular to the line $a\ c$ or $d\ c$ drawn through the extremities of the given arc and the center c, it cannot be the sine of the arc $a\ b\ d$. The sine of the arc $a\ b\ d$ is the line $a\ o$ drawn from the extremity a of the arc $a\ b\ d$ perpendicular to $d\ c$; but the line $a\ o$ cannot be so readily obtained. We therefore divided the angle $a\ c\ d$ into two equal parts, and thus obtained a line $b\ c$ perpendicular to the chord $a\ d$, so that we may consider the line $a\ r$ (which is one-half of the chord $a\ d$) to be the sine of one half the given arc. The lengths of the lines $a\ r$ and $a\ c$ are known, and therefore the number of degrees in the angle $a\ c\ r$, or, which amounts to the same thing, the number of degrees in half the angle $a\ c\ d$, are readily obtained as explained; consequently, by multiplying the number of degrees in the angle $a\ c\ b$ by two, the number of the degrees in the angle $a\ c\ d$ are determined with the least amount of labor.

Problem 59.

422.—To find the intersection of a prism and a cylinder, the cylinder being passed through the prism.

Let Fig. 309 be the vertical, Fig. 310 the horizontal projection, and Fig. 311 a side view, of the given prism and cylinder. The faces of the prism form an angle of 45 degrees with the vertical plane of projection, the lateral edges are perpendicular to the horizontal plane of projection, the cylinder is passed through the prism with its axis parallel to both planes of projection. It is required to find the lines of intersections.

In Fig. 310 the square $a_2\ b_2\ c_2\ e_2$ is the horizontal projection of the prism; the rectangle $j_2\ k_2\ m_2\ n_2$ the horizontal projection of the cylinder, and the line $f_2\ g_2$ is the horizontal projection of the axis of the cylinder. In Fig. 309, $a\ a_3\ c\ c_3$ is vertical projection of the prism, $a\ a_3$ being an edge which is represented in Fig. 310 by the point a_2; $c\ c_3$ is another edge corresponding with the point c_2; the line $b\ b_3$ and the point b_2 representing an edge between the two former ones. The rectangle $f\ g\ h\ i$ is the vertical projection of the cylinder. In Fig. 311 the circle is the projection of the cylinder with its axis perpendicular to the vertical plane of projection. The lines $a_4\ a_5$ and $a\ a_3$ (Fig. 309) represent one and the same edge, $b_4\ b_5$ and $b\ b_3$ represent another edge, and the line $e_4\ e_5$ represents an edge which in Fig. 309 is hidden by and coincides with the line $b\ b_3$. In Fig. 311 it is plainly seen that the cylinder cuts away a portion of the edge $a_4\ a_5$; the amount that is cut out of this edge is equal to the diameter of the cylinder, and since in Fig. 309 the distance between the lines $f\ g$ and $h\ i$ is equal to the diameter, it follows that the points 2 and 11 in which the lines $f\ g$ and $h\ i$ cut the line $a\ a_3$ are points in the curve of intersection. Now, in order to find more points in the same curve of intersection we proceed as follows:

In Fig. 310 divide the distance from the point f_2 to j_2 into any number of equal parts, say three parts, and let o_2, q_2 be the points of division. Through the points o_2 and q_2 draw the lines $o_2\ p_2$, $q_2\ r_2$ parallel to the axis $f_2\ g_2$ of the cylinder, and cutting the line $a_2\ b_2$ in the points a_6, a_7. In Fig. 311 draw a line $b_8\ b_9$ parallel to the line $a_4\ a_5$ and tangent to the circle.

Divide the distance from a_4 to b_8 into three equal parts, and let b_6, b_7 be the points of division. Through these points draw lines parallel to $a_4\ a_5$, cutting the circumference in the points 6, 10, 7 and 9. Through these points draw the horizontal lines $6o$, $7q$, $9q_3$ and $10o_3$. Again, through

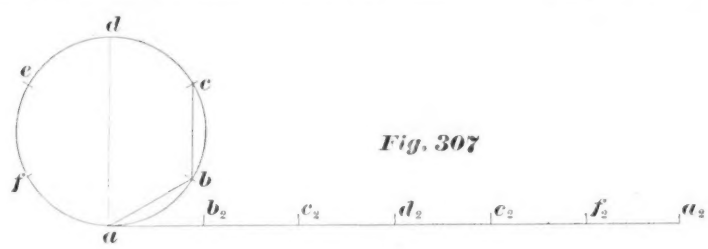


Fig. 307

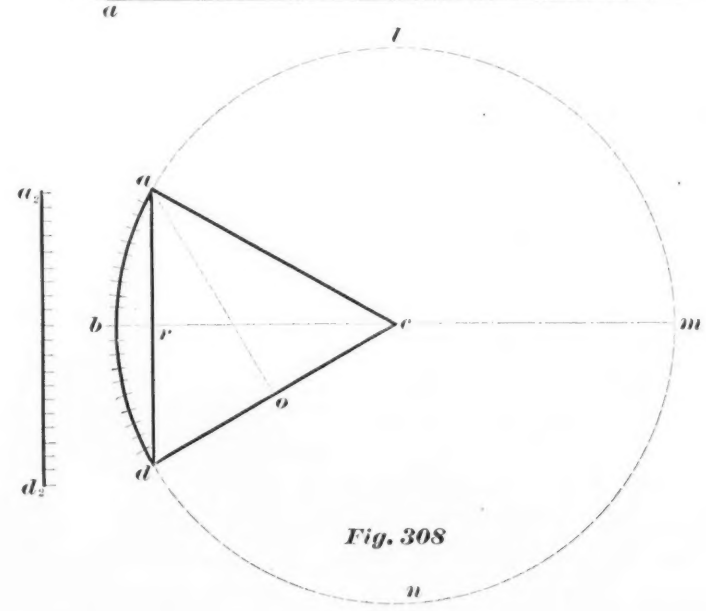


Fig. 308

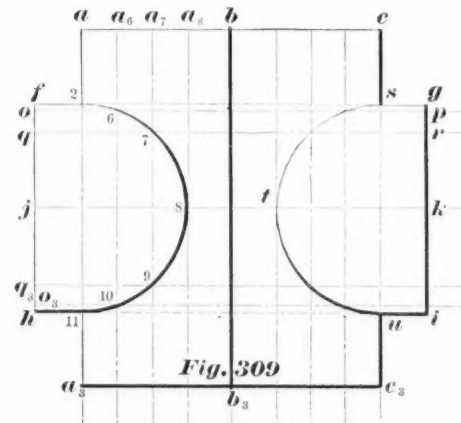


Fig. 309

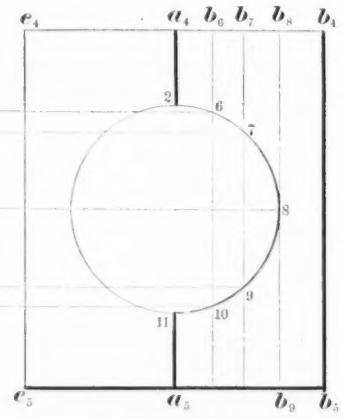


Fig. 311

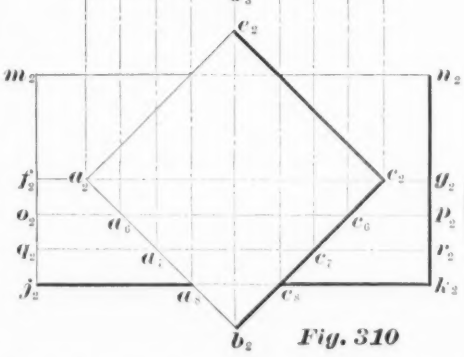


Fig. 310

the point a_6 (Fig. 310) draw a vertical line, cutting the $6o$ in the point 6, and the line $10o_8$ in the point 10; the points 6 and 10 will be another two points in the curve of intersection. Through the point a_7 (Fig. 310) draw a vertical line cutting the horizontal line $7q$ in the point 7, and the line $9q_3$ in the point 9; these two points will also be points in the curve of intersection, and lastly, through the point a_8 in which the line $j_2\ k_2$ pierces the face $a_2\ b_2$ of the prism, draw a vertical line, cutting $j\ k$ in the point 8. Now join the points 2, 6, 7, 8, 9, 10, 11 by a curve which will be the line in which the cylinder intersects the face $a\ a_2\ b\ b_2$. In a similar manner the curve $s\ t\ u$ is found. The principle upon which this construction is based will be explained in our next paper.

Directions.—In space marked Prob. 59, draw a prism whose bases are 5 inches square, the length of the prism 9 inches, the cylinder $4\frac{3}{4}$ inches in diameter and 9 inches long. The cylinder and prism are to occupy the same relative positions to the planes of projections as shown in the figures. Find the lines in which the cylinder will cut the faces of the prism. Use 3 inch scale.

George H. Corliss.

In a recent issue we briefly referred to the death of George H. Corliss, news of his death reaching us too late for anything like an extended notice of his life. Since then an excellent sketch of his life has appeared in the Providence *Journal*, written by John A. Coleman, from which we extract as below:

* * * By a fortunate accident Mr. Corliss, when a young man, came to a Rhode Island steam engine establishment to construct a sewing machine of his invention. While thus engaged he was diverted from his purpose by an exigency suddenly occurring in the establishment, and his attention was thenceforward directed to the improvement of the steam engine. The invention of the attachment of the James Watt Regulator to a liberating valve gear was the result.

To the lay mind this statement will possess little significance, and an explanation of the nature of the improvement would be more satisfactorily obtained from a scientific work upon steam than can be furnished upon the present occasion. Suffice it to say that this improvement produced so great an economy in the consumption of coal in manufacturing establishments, that the Corliss engine in time superseded all others. It also enabled a uniform speed of the machinery in manufactories of textile fabrics to be obtained by its almost human intelligence in regulating its own power to its constantly varying work.

For the first time in the history of cotton spinning could the machinery of a mill be run without jerks, and the consequent breaking of threads throughout the mill, with the attendant vexation and loss Probably no more potent factor entered into the cotton industry of America to establish it upon a profitable basis than the Corliss steam engine.

The effect upon other industries was equally marked, and eventually scarcely any other engines were to be found in first-class establishments employing steam power.

In 1867 the Corliss engine was exhibited in Europe for the first time at the Paris Exposition, where it received the highest awards, and the engine was copied throughout Europe to such an extent that at the Vienna Exposition in 1873 out of about four hundred engines the majority was of the Corliss type, and Mr. Corliss again received the highest awards, although not a pound of machinery, nor even a drawing, were exhibited by him. Again at Paris in 1878 scarcely one engine was shown out of hundreds built upon any other plan. It may be said to be the standard form of stationary engine, in pure or modified form, throughout the civilized world.

The success of the Corliss engine in America was not reached in a moment. Like all great innovations, at the commencement it was assailed by established prejudices and vested interests with vituperation and scorn. This was not strange. The strong individuality of the inventor was emphatically characteristic of his engine. Radically different in theory, operation and appearance, elegant and refined among engines, as its inventor was among men, and moreover being in all things *right*, it was inevitable that it should not escape condemnation by the least enlightened of those professing to be steam engineers.

The writer remembers the scornful derision with which this class greeted the first appearance of the present form of engine-bed, which is copied to-day over the entire civilized world. The bitter days of the early history of the Corliss engine are not yet forgotten by many who still survive.

Through all discouragements and attacks Mr. Corliss pursued his way with steady, inflexible purpose, to carry out principles which were believed, and have since proved themselves to be right, in the construction of machines for steam power.

It required courage to face the entire engineering world in those early days of ignorance and prejudice. It was only men of like courage and radical type who would purchase the first engines. Mr. Corliss set a high standard for himself, and he lived up to it. Like begets like, and he attracted to himself the best customers, and surrounded himself with a corps of assistants who were the highest type of their kind.

Not only did Mr. Corliss invent a steam engine of new principle, but his effect upon the art of constructing steam engines in this country was equally marked. There is not more difference between a Waltham and a Waterbury watch than existed between the workmanship of a Corliss engine and the common steam engine of forty years ago. Engine manufactories of that time were generally coarse, crude and unsystematic. Disorder, slovenliness, and dirt were their prevalent characteristics. The buildings were apt to be inconvenient, laid out at random, and such a thing as a thoroughly conceived and matured plan of manufacture was an unknown quantity.

The Corliss plant stands to-day as a living evidence of the change wrought in steam engine manufacture, and is a monument to the genius of a man only 30 years old when he created it—a man, be it remembered, never educated as an engineer or an architect, and never inside a machine shop until he was 24 years old. In the years following his invention the Corliss engine became the standard of excellence for workmanship throughout the United States. The best praise of an engine built elsewhere is to say, "it is as well built as a Corliss." The mammoth corporations of Lowell, the Blackstone Valley and elsewhere depended implicitly upon the engineering judgment of Mr. Corliss to the last.

Pluck and daring were eminent engineering characteristics of Mr. Corliss. These were exhibited in such engines as those at the Merchants' Mills in Fall River, when he startled the engineering world by a fly wheel thirty feet in diameter at the rate of a mile a minute. Experienced engineers quailed before such an experiment, but it was a success, and many similar engines are in daily use.

His engineering career has been one of bounding leaps beyond his competitors.

The last great act of his life for the revolution of the art of building engines had drawn to completion at the moment of the close of his industrious life. For three years past, at the age when most men are glad to retire from active duty, he has been engaged in applying to the steam engine manufacture the principles upon which guns and pistols are made.

He has perfected an organization of machinery by which three large engines can be turned out every ten hours; the components of the engines being perfectly interchangeable, precisely as are those of the weapons named. * * *

The policy of converting compound engines to tri-compound is being steadily pursued by the directors of the Union Steamship Company. The R. M. S. Moor has just had her engines converted to the triple expansion system, making the fifth of the company's mail steamers which have been so dealt with. The work has been executed by Messrs. T. Richardson & Sons, of Hartlepool, who have supplied the Moor with new boilers, working at a pressure of 160 pounds per square inch. The diameters of the cylinders are 34 inch, 56 inch, and 90 inch respectively, and the length of stroke 60 inch. Whilst the alteration of the Moor's engines was proceeding, advantage was taken of the opportunity to fit her throughout with a complete installation of electric lighting, and with refrigerating machinery and a cold room. The Moor underwent her speed trial at Stokes Bay on Wednesday, 15th February, when she attained a mean speed of 16 knots per hour, and indicated 4,532 horse-power. The engines worked at 70 revolutions per minute, with a pressure of steam in the boilers of 160 pounds per square inch. Compared with the Moor's performance on trial with compound engines, this shows an increase in speed of over three-quarters of a knot per hour, and an additional 232 indicated horse-power.—*Engineering.*

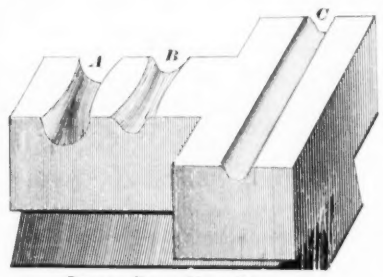
Practical Details of Blacksmithing.

By B. F. SPALDING.

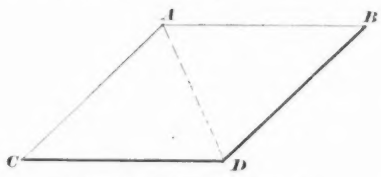
TRIP-HAMMER DIES.

There is no form of dies used under the trip-hammer in which stock can be drawn to size as readily as it can be in that form which makes the stock round, for the sides of the grooves restrain it from extending in width, and thus nearly the full effect of the blow is materialized in extension in length. This might be said of that right angle **V** form of dies used for drawing stock accurately square, but other circumstances are introduced, and the fact that no form works with so little satisfaction, leads to the belief that some of the force is wasted in driving the stock down the inclines at the sides and jamming it in. This makes trouble in turning, or in moving the stock back and forth. These dies work hard and cramped, and do not allow of free movement on the part of the workman. With rounding dies, the contrary is the case.

Dies for drawing straight, round stock, well finished, should have their faces of a **T** shape, and have three impressions sunk or cut in them, viz.: the "break-down" *A*, the "drawing" *B*, and the "straightening" *C*. The "break-down" and "drawing" should be across the narrow part of the **T** and the straightening across the broad part. The "break-down" impression should be flared enough or should be made of a circle so



Lower Rounding Die.



Rhombic Figure, Showing Probable Line of Fracture.

large that the stock will not be "chawed up," mutilated or flawed. For instance, if $1\frac{1}{2}''$ stock is to be drawn to $1''$ the break-down impressions should be of the circle of $1\frac{1}{2}''$, and each of them should be $\frac{1}{2}''$ deep. The size of the stock is gauged by the depth of the impressions. If the dies are securely clamped together, with the faces toward each other, but with a piece $\frac{1}{2}''$ thick inserted between them, and the hole for the break-down impression is drilled in this with a $1\frac{1}{2}''$ drill, the width and circle of the impression will be right. The die has now to be worked out in such shape as, if cut across through the bottom of the impression, it will show highest in the center, and be rounded down at the sides to conform to a circle of about $4''$. If nearly $2''$ long it would present the appearance of having been filed out $\frac{3}{4}''$ deep at the ends and $\frac{1}{2}''$ deep in the center, with a round file $1\frac{1}{2}''$ in diameter, and having the corners afterwards rounded.

To make the drawing and straightening impressions the dies are firmly clamped together, face to face, and holes of the proper size are drilled in them, half of the diameter in each die. This is a good rule, although there are some cases where it is rather better to put more than half the diameter in the lower die, and some triphammersmen advocate this as a general rule, simply because their experience has been greater with the class of work which called for that form.

After the holes are drilled, and the dies taken apart, the sharp corners formed by the die faces and the sides of the drill holes must be removed. In the drawing die this should be done more toward the ends than in the center. They should be taken off enough so that when a cylindrical piece, of the diameter which they are intended to draw, is placed between the dies, in the groove, they will not touch it on more than two-thirds of the circumference. This allows one-twelfth of the circumference to be taken off from each corner in the middle, and more than this should be removed at the ends. The reason for this is that the workman does not hold himself perfectly rigid, and the work may not be held, in all its turnings around, perfectly in line with the impression, and by using this precaution the dies are prevented from marking it.

The corners of the straightening impressions do not need to be taken off as much as those on the drawing die, as, when the stock is ready to enter this die, it is supposed to be very nearly down to the right size, leaving nothing more to be done to it than to joint up, smooth and straighten. If, after the corners are removed, there is three-fourths of the circle remaining intact, it will be enough; and on this die the precaution of taking off considerably more of the corner, near the ends of the impression, need not be observed, as the groove is long enough to make it an easy matter to keep the work in its place, and straight with the groove.

When there is great risk that the piece which is being worked on will roll or jump out of the lower die, and get caught out of place by the descending stroke of the hammer, it is a matter of safety to have as much of the impression in the lower die as can well be afforded. Some give as a rule to put one-third of the depth of the impression in the upper die, and two-thirds in the lower die. This is rather going to the extreme for general work, and does not allow the upper die to cover as much of the surface of the stock as it can work to advantage.

If the tendency is to jump out of the die, it can be corrected by putting a guard up close to the dies, so forked for the stock to lie in that it cannot jump out. A good plan, in some respects, is to attach this guard permanently to the die, as, unless some accident happens, it will not then get separated from it when it is not in use, and is always ready fixed when the die is wanted for use. One objection to this is the making of extra holes in the dies, and thus weakening them; for although a hole drilled at the end of a crack will break its continuity and prevent its further progress, yet if the hole had been drilled there in the first place, the crack would have been thus invited to come. Another objection is their liability to get knocked off, which generally entails the digging out, or drilling out, of the broken screws. The guards are sometimes keyed in beside the die, but a better way is to have tapped holes in the side of the hammer die block, or anvil, and attach them with bolts. These holes are also often convenient for fastening on gauges, or other appliances, which are wanted on different kinds of work.

The breaking-down dies draw out the stock rapidly, working as a pair of hollowed $4''$ fullers. The stock should be given a quarter turn at each stroke, sometimes over and over, and sometimes over and back, as may be required to keep it from getting crooked. Working it into the dies with a screw motion, with a turn of more or less than a quarter, has a great tendency to make it split, and is injurious. The central line of compression should always be directly across the center of the stock. A glance at the rhombic figure resting on the surface *C D* will show that a blow struck on the surface *A B* will have a tendency to produce a fracture in the direction of the dotted line *A D*, while if it is turned to rest on the corner *C*, and receives a blow on the corner *B*, no such tendency will exist.

The break-down dies, if made and used right, will leave the work very rough, not round, but in a succession of ovals, each about half as long as the die is wide, and standing at right angles to each other.

More skill is necessary in using the break-down than either of the other impressions, but there is need of care in the use of the drawing die to prevent the work from being

flawed. On the finishing die water is sometimes used to separate and throw off the scale, which is otherwise liable to accumulate in the long groove and produce work as rough as though the worms had eaten it. A blast pipe should always pour a current of wind upon the dies to blow the scales from the faces, or they will drive down and eat holes in them. These scales are harder than the hardest steel.

These dies are properly gauge dies. When the faces strike together, the stock, if properly handled, must come to be of uniform size, and it can be drawn as exact in size and made as round with these tools as it can be made in any other way, even by cold rolling. They have been used for such exact work for many years. Spindles for textile machinery are drawn with great accuracy. Gun ramrods are rounded with special tools under the hammer, and other things are worked with great closeness. As gauge dies, these here described depend for their accuracy upon maintaining the difference between the bottom of the impression and the face of the die. Sometimes the groove will wear out large, and sometimes the faces will batter down, and thus make the groove small. The impressions in small steel work generally wear down first, while on iron work of any size the contrary is most likely to be the case. Cast-iron can be used for dies with advantage, very often, when the work is above 1½".

The uses of the power hammers are not yet fully appreciated, although the improvements which have been made in them by the ingenuity of modern mechanics, has brought them into prominent notice as labor saving machines. The finest work which they have been used on is probably hammering the brass rims of the watch chronometer balance wheels. This was done in E. Howard's establishment, in 1865, for the purpose of securing uniform density of material.

The teeth in section plates for reaper knives have long been cut with small trip-hammers, in which gun metal has been found the best material for the helves. Files have also been cut with small trip-hammers for many years.

LETTERS FROM PRACTICAL MEN.

How to Make the Inspirator Work.

Editor American Machinist:

Duncan McFarlane can stop his inspirator trouble by cutting his two-inch pipe as close to the bottom as he can thread it, and then enlarging it to a six-inch pipe, which should be about five feet long, plugged at the top, and should have a half-inch pipe running up above the water-line, so as to let the air escape. Air will surely get into the stand pipe, especially on a flat bottom barge in a storm; air bubbles run along the bottom, and the slightest suction will draw them into the stand pipe. The two-inch pipe should run into the six-inch pipe about a foot. The feed pipe should be tapped into the stand pipe three inches from the bottom. It will be cheaper, and a better job, to enlarge the two-inch pipe than to run the six-inch pipe through the hull.

Geo. J. Mashek.

Marinette Co., Wis.

Editor American Machinist:

In your issue of March 3, 1888, Duncan McFarlane asks for information as to the working of his inspirator, which has puzzled him so much.

If he will screw a 2-inch L on the end of the pipe in the water, pointing in the direction in which the boat runs, I think he will have no more trouble.

E. J. Rooksby.

631 Arch st., Phila.

Stress in a Rope.

Editor American Machinist:

Will you allow me a little space to say a few words in regards to stress in a rope?

I tried a few pleasing experiments after the question in Jan. 28th. I bought two new spring balances as accurate as I could find them, and arranged them as in Fig. 1, and hung a weight of eight pounds on the lower one, when they both indicated eight pounds, showing the action of one is the action of the other, and the cross bar subject to a strain of eight pounds, plus the weight of the balances. I now arranged them as in No. 2, and again hung the weight of eight pounds on the two. They each indicated four pounds, proving that each balance carried half the weight, and there was still a strain of eight pounds on the cross bar. I now arranged it as in Fig. 3. I took a stout string six feet long; in the center I hung a weight of one pound. I let the rope sag one inch, when the balance indicated 18 pounds; then arranging the parallelogram of forces to this

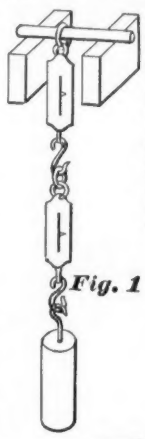


Fig. 1

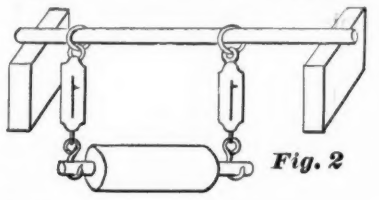


Fig. 2

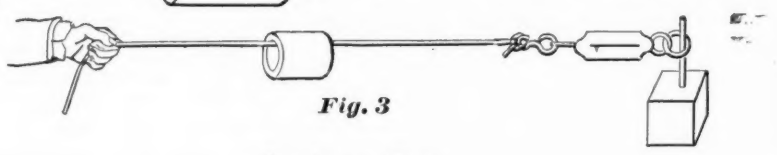


Fig. 3

Stress in a Rope.

effect, and calculating the same, it came out correct, showing that theory and practice must agree; if it does not, it is either poor theory or bad practice.

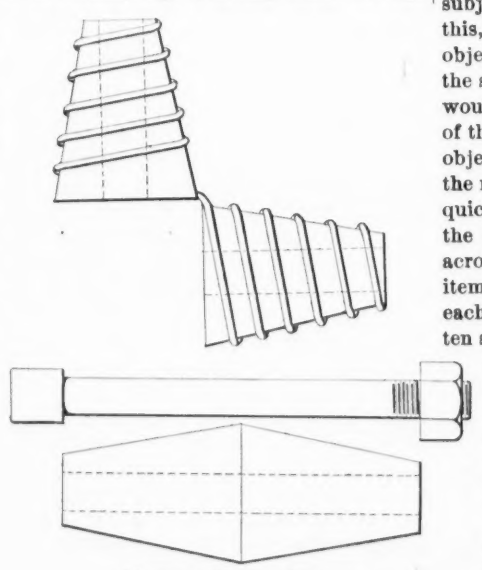
I then tried to pull the string taut, but my balance only indicated to 25 pounds, therefore I could not tell the stress in the rope.

Edward D. Gleason.

Making Spiral Springs.

Editor American Machinist:

Noticing in your issue of February 11 a method of making conical spiral springs, by Charles Pratt, which seems rather slow and expensive, and having had considerable experience in making such springs, I send you a sketch of an arbor for the purpose. There are several methods that are good; one of them is to make an arbor consisting of two cones, Fig. 1, having holes through



Making Spiral Springs.

them to receive a bolt. This bolt is put through the cones, the nut tightened up, and the spring wound in the usual manner; then the bolt being withdrawn, the spring can be sprung in the manner indicated by Fig. 2, and the cones taken out. When only a small number are needed they can be made on wooden arbors, which can be sawn in two and taken out in the same manner.

Jas. H. Westcott.

Would Like To Know.

Editor American Machinist:

I would like to know if any reader of the American Machinist has ever tried the experiment of making iron or steel castings by surrounding the flask with a powerful electro-magnet during the pouring process, or if it is known what effect would be produced upon molten iron or steel treated in this manner? If additional strength or improved polarity in dynamo castings can be obtained, it will amply pay for the experiment, which can be cheaply made in foundries where electric light plants are in use. Will some one try it and publish the result?

C. W. Crawford.

Shop Inventory.

Editor American Machinist:

While making our inventory a suggestion by our foreman that there ought to be some way to save doing so much writing over and over again, and that if we would have everything throughout the entire establishment stamped or marked with a number of its own, much time might be saved and a far more satisfactory result obtained. No doubt these things have been suggested hundreds of times before, but there is one or two points that have occurred to me that I do not remember of having seen mentioned. First, in numbering, he suggests to divide things into groups or classes, and then skip at least half the numbers in the first numbering—that is, take, say, machines. Beginning with 2, 4, 6, etc., so that new machines could be added and numbered in about their proper place, and allow at least four times the numbers, or enough so as not to have them run short for ten years. Assume a firm had 50 machines; let them appropriate 200 numbers to machines, and begin the next class, say, jigs. and fixtures at 202, beginning the third class at 400 or 500, as the probabilities of the business would demand—that is, follow the system of numbering used in Philadelphia for streets.

There may be plenty of establishments where this would not be "in the figures," so to speak, and when the only plan would be to begin each class at 2, and thus leave the subject of extension unlimited. But to this, in most industries, there would be an objection. A half dozen things would bear the same number, so that the miscellaneous would bother in carrying out the balance of the plan which I have to suggest. The object of the numbers is to facilitate finding the name or use of the thing or its valuation quickly, and the suggestion for the form of the inventory book is this: Use one line across the two adjacent pages for each item. Put the number, name, and use of each thing on the first page, and a series of ten sets of dollar and cent lines on the second page, and these ten sets of lines make the inventory book good for ten years, showing at a glance by the entrance of value which year the thing was added, if not in use originally.

A hasty glance at this scheme will show many good points. In taking inventory, one can take the things as he comes to them, turn at once to its name, use, and former value, and enter the estimate, regardless as to whether it was in the same part of the shop the year before or not. New things can be entered in the book when they are made or bought, and the cost or value entered at the time. After the book is first written up, and the additions filled in as they are made, there is no other writing to do for ten years.

In the case of things that cannot well be numbered, owing to size, hardness, etc.—such things are usually small and in large numbers—put all of a sort in a box, number the box, and note number of pieces in the box in the book.

In many places business is carried on by order numbers. With this method of numbering things in the shop—if at any time a repair was to be made on a tool or machine and a cost account kept of it—it could be carried along by using the number of tool or machine in place of the name. That is to say, instead of writing out—"Repairs on the Fitchburgh Machine Company's seventy-two inch lathe," "Repairs on No. 27" would imply the same thing and be much shorter, and so for any purpose wherever in business it became necessary to refer to a tool, the tool number would answer the purpose.

John E. Sweet.

Copper-Covered Posts in a Shop.

Editor American Machinist:

We came near having a serious accident at the mills here [Benedict & Burnham M'f'g Co.] the other day. There is a muffler room 50 feet wide, and a mill room nearly 100 feet wide, with truss roofs, and the junction of these roofs is supported on Georgia pine posts. Where part of one of the buildings is two stories, there are two posts. There being water and pickle tubs standing near some of them, they were covered with sheet copper some three or four feet high. Last week it was accidentally discovered that one of these posts was completely rotted off under the copper, dry rot having set in. An examination showed all that were copper covered to be in the same condition, while those that were not covered were all right. Two of the posts had begun to settle, and what sustained the roof is a mystery.

W. E. Crane.

Waterbury, Conn.

The Ice Boat Question.

Editor American Machinist:

I would like to offer a few words of explanation of an ice boat moving faster than the wind, in answer to question No. 92.

The highest speed is shown when the sail is nearly in line with the keel and the wind at right angles to the course.

Let J. R. Z. place a 60° triangle on the table, and consider the perpendicular as keel and the hypothenuse as sail. Then place one finger against the perpendicular and another against the hypothenuse, and crowd the triangle between them. It will be readily seen that the boat will go ahead the length of the perpendicular, while the wind moves the length of the base.

The resistance of an ice boat is so light that there is power enough with the sail in such a position to make a very high speed.

H. A. Whittemore.

Grand Rapids, Mich.

Milling vs. Planing Metals.

Editor American Machinist:

You are probably aware that I am a strong advocate of the milling cutter for all machine shop work, where it is possible to use it; and I had an idea that most of our master machinists had a similar liking for this tool. Having this opinion rather firmly fixed, the statements of Mr. F. L. Johnson, regarding the comparative merits of the milling and planing machines, surprised me as much at they did friend Conradson, of Milwaukee.

There is a well-known company in the Eastern States who have been using sixteen planers for the past twenty years, and are now about to adopt the heavy milling machine system in place of the planers. In other words, there will be but three or four planers in their establishment, the others being replaced by seven special milling machines. This plan was decided upon after many comparative trials of the two systems, working in both wrought and cast-iron.

I think there must be something wrong about Mr. Johnson's experience with milling machines, and this may not be his fault; for if the machines used by him were not designed with a rigid structure, then failure was the most natural result.

Mr. Conradson strikes the nail on the head when he says, "The chief reason, in my opinion, that the milling machine is not used more extensively is this—the proper machine has not been put on the market.

The average milling machine has a spindle much too small; the table is too shallow; the bed is weak; the driving power fails on heavy cuts, and the feed is a complete failure."

Let Mr. Johnson try a plan adopted by the writer some years ago, viz.: changing a good stiff 26″×26″×5 foot planer to a milling machine. I milled to a standard gauge in width and thickness pieces of hard cast-iron 5″×2″×46″, which were impossible to produce on a 36″×36″×10 foot planer, and they could not be fitted together without grinding the pieces after they left the planer. I had no trouble in cutting 38 square inches per minute in a metal very much harder than that used in a good steam cylinder. There is no planing machine equal to a stiff milling machine for accurate work. W. H. HOFFMAN.

94 Liberty Street, New York.

Transmission of Heat Through Thick and Through Thin Plates.

Editor American Machinist:

In your issue of March 3rd, Mr. Richard H. Buel brings in question the statement that thin plates have any advantage over thick ones on the rate of evaporation in steam boilers.

My experience in constructing boilers for running sewing machines and other light machinery in the years 1870 and 1871 proved conclusively that heat is transmitted through thin plates much more rapidly than through thick ones.

I constructed boilers 8″ in diameter, 18″ high, with four 2″ thin copper tubes No. 27 gauge, made slightly tapering, large end at the bottom.

Kerosene lamps were made with four ordinary No. 2 burners placed to fit each tube, which acted as a chimney for the burner.

Fill the boiler with 2½ gallons of water and trim the lamp wicks to make as large a flame as possible without smoking, and steam could be made sufficient to run any family sewing machine on the market six or eight hours without refilling with water. I found that said tubes would collapse at a pressure of 15 lbs. per square inch; to remedy this I made tubes of thicker material, No. 20 gauge, but it was impossible to make steam enough to run a sewing machine with four lamp burners. I then strengthened the thin tubes with a coil of No. 10 steel wire, flattened and wound ¾″ apart to fit the inside of the tube; with this coil inside the thin tubes they would stand a pressure of 75 lbs. per square inch, and with the four burners would make steam as fast as without the wire coil inside.

It is also a well-known fact that thick plates in a fire box exposed to great heat will burn down to about ⅜ inch thick, and remain so, unless mud or rust causes them to get thinner. E. NICHOLSON.

Cleveland, O.

Setting Lathes in Line.

Editor American Machinist:

Your reply to question of C. L., New York (No. 78, Feb. 18, 1888), "Simple process by which I can know that a lathe is set straight," is all right but not always convenient or necessary, unless for a very particular job. If the centers are trued up (as they should be) and sharp, by moving the tail stock up close to the head, and bringing the points of the centers carefully together and looking down from above, it is easy to see with a good eye whether or not they near enough in line for ordinary work, especially work of any length. This is also good practice before setting by a trial cut or cuts. By placing the eye on a level with the two centers it can also be seen if they are much out of line up and down—which is frequently the case, and much more difficult to correct.

Most lathes have marks to set them by, often several of them, from the finest scratch to the chisel mark, so that one can seldom tell which is right, and could not set the lathe exactly by them if he could tell. A good authority says all lathes should be provided with a taper pin to adjust them by. This is all right so long as they are in line vertically.

C. L. will find it no mean job to set his lathe so that it will turn exactly the same size at each end, either by taking one cut or a dozen, and the shorter the trial piece is, the better; for the variation is the same in two inches or two feet, to say nothing of the wear of the tool, spring of the piece, time, etc.

These remarks are intended for young machinists; old ones already know all this.

CENTER PUNCH.

Foundry Cupolas.

BY ROBERT E. MASTERS.

Fig. 1 is a cupola with a continuous tuyere, the tuyere iron being bolted to the shell at *A A* with a spool or pipe over the bolt at *B*, forms an inside air chamber and supports the brick above the tuyere *C*. As this is a clear opening all the way around the cupola, the blast enters the fuel at all points. The blast pipe connects with the air chamber on a line with *D* on one or both sides or at the back. This well known style of cupola gives us an average result as follows:

CUPOLA REPORT, OCTOBER 5, 1887.

Melting in Tredegar Iron Works, lower foundry. Class of castings, rolling mill, general machinery and jobbing work.

DIMENSIONS OF CUPOLA AND BLOWER.

Style of cupola	Mackenzie, oval shape.
Outside diameter	7′ 6″ x 5′ 6″
Thickness of lining	9″
Inside diameter at tuyeres	6′ x 4′
Largest inside or melting point diameter	6′ 6″ x 4′ 7″
Inside diameter at charging door	6′ 1″ x 4′ 2″
Height from bottom plate up to bottom of charging door	8′ 10″
Style of tuyeres	Continuous.
Size of tuyere	1″ opening.
Height from bottom plate to bottom of tuyere	14″
Height of tuyere above sand bottom on back side	6″
Size and name of blower	Sturtevant, No. 9
Size and length of main blast pipe	16″ dia., 220′ long.
Size and length of branch pipes.	10″ x 12″ oval, 12′ long.

MODE OF CHARGING CUPOLA.

Fuel used for bed	Coal 1,800 lbs.
1st charge of iron	Scrap 4,200 lbs. Pig 2,800 lbs.
1st charge of fuel	Coal 800 lbs.
2d charge of iron	Scrap 3,600 lbs. Pig 2,400 lbs.
2d charge of fuel	Coal 800 lbs.
3d charge of iron	Scrap 3,600 lbs Pig 2,400 lbs.
3d charge of fuel	Coal 800 lbs.
4th charge of iron	Scrap 3,600 lbs. Pig 2,400 lbs.
4th charge of fuel	Coal 800 lbs.
5th charge of iron	Scrap 3,600 lbs. Pig 2,400 lbs.
5th charge of fuel	Coal 800 lbs.
6th charge of iron	Scrap 3,600 lbs Pig 2,400 lbs.
6th charge of fuel	Coal 800 lbs.
7th charge of iron	Scrap 3,600 lbs. Pig 2,400 lbs.

MODE OF WORKING CUPOLA.

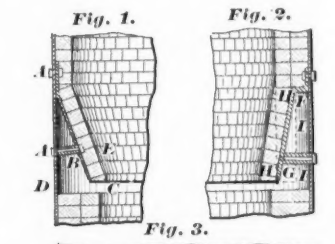
Time of starting fire	11.10 o'clock	A. M.
Time of charging first iron	12.20 o'clock	P. M.
Blast put on	2.00 "	P. M.
First appearance fluid iron	2.04 "	P. M.
First stopped in	2.10 "	P. M.
Bottom dropped	5.30 "	P. M.
Revolutions of fan		1,950
Pressure of blast		6½ ounces
Quality of fuel		First-class
Kind of flux used		Oyster shells
Quantity of flux per ton of iron		Common shovel full

TOTALS.

Amount of iron melted	43,000 lbs.
Amount of fuel consumed	6,600 lbs.
Ratio of fuel to iron used	1 to $6\frac{51}{100}$
Fluidity of melted iron	Hot

A pitch in a cupola as at *E* causes it to cut away a great deal faster than if it was straight, and therefore requires the lower part to be lined up oftener. In a cupola of the same style, but 8″ less in diameter we modified the pitch by casting new tuyere irons straight at *F* and slanted to *G*. This foundry was engaged on car and locomotive castings, and on the same day as the foregoing heat we melted 33,000 pounds of iron at the rate of 1 of fuel to 6¾ of iron, in 2 hours and 30 minutes, blast being furnished by a No. 5 Roots rotary blower, running 135 strokes per minute. The blast pipe was 16″ diameter and 130 feet long. I mention these points because they have a bearing on the result.

In another cupola of this same pattern I made the air chamber and lining straight, as shown by the dotted line *H* for the lining and *I I* for the tuyere segments, and obtained a still higher percentage of iron to fuel. Mr. W. W. Snow, General Manager of the Ramapo Wheel and Foundry Company, told me they had a large cupola on the plan of Fig. 1, and they took out the tuyeres, cut six holes in the shell equal distances apart, and put an iron frame in each, with an opening 1½″ x 12″, as seen at *J J* in Figs. 3 and 4. Fig. 4 is a view of Fig. 3 cut through at *K K*. The cupola was lined up straight and an air chamber or bustle *L L* put around the outside, the blast pipe entering at *M*. Mr. Snow says it works a great deal more to their satisfaction on this latter plan. We have lined these cupolas up straight on the 1st of January, and run them through the year without relining, melting from 25,000 to 40,000 pounds of iron daily.



FOUNDRY CUPOLAS

Fig. 5 is a section of Fig. 6 cut through at *N*. The tuyere irons *O* are cast in segments to form the circle. There is an upper and a lower piece to each segment. The lower sections *P* have oblong and round projections *R R* cast on them 1¾″ long; the upper plate *S* is plain, and rests on these projections, and both are fitted under the angle of the air chamber plate *T*. These tuyere segments can be removed at any time and replaced with new ones. I called on Mr. Jas. Woodall, foreman of the R. and D. R. R. Foundry, and obtained the following report of the working of this cupola.

CUPOLA REPORT.

MANCHESTER, VA., Dec. 14, 1887.

Melting in Richmond and Danville R. R. Foundry.

DIMENSIONS OF CUPOLA AND BLOWER.

Style of cupola	Sellers.
Outside diameter	55 inches.
Thickness of lining	9 "
Largest melting point diameter	36 "
Inside diameter at charging door	44 "
Height from bottom plate up to bottom of charging door	8 feet.
Tuyeres as described above.	
Size and name of blower	Sturtevant, 40 in.

MODE OF CHARGING CUPOLA.

Fuel used for bed	Coke 500 lbs....Coal 400 lbs.
1st charge of iron	Scrap 1,400 lbs...Pig 600 lbs.
1st charge of fuel	Coke 100 lbs....Coal 70 lbs.
2nd charge of iron	Scrap 1,600 lbs..Pig 400 lbs.
2nd charge of fuel	Coke 100 lbs....Coal 70 lbs.
3rd charge of iron	Scrap 1,600 lbs..Pig 400 lbs.
3rd charge of fuel	Coke 100 lbs....Coal 70 lbs.
4th charge of iron	Scrap 1,600 lbs..Pig 400 lbs.
4th charge of fuel	Coke 100 lbs....Coal 700 lbs.
5th charge of iron	Scrap 2,000 lbs.

MODE OF WORKING CUPOLA.

Time of starting fire	1 o'clock	P. M.
Time charging first iron	2.30	"
Blast put on	3.30	"
First appearance of fluid iron	3.40	"
First stopped in	3.42	"
Bottom dropped	4.35	"
Revolutions of blower		1,200
Pressure of blast		8½ ounces.
Kind of fuel used		Coke and Anthracite coal
Quality of fuel		Ordinary.

TOTALS.

Amount of iron melted	10,000 lbs.
Amount of fuel consumed	1,580 "
Ratio of fuel to iron used	1 to $6\frac{3}{10}$

The blast pipe is 10″ diameter, 10 feet long, and is direct from the fan to the air chamber at *N*, no branch pipes being used. The fan is run by a 1″ wire cable working on two 7 foot sheaves 125 feet apart; a good strong blast is obtained.

Fig. 1 is a section view of the Truesdale cupola, showing a vertical series of graduated tuyeres *V V*. The air chamber *W* connects with the upright blast pipes at *X*, with a peephole at *Y*. The P. H. and F. M. Roots Co. have this cupola in operation in their foundry, and Mr. D. T. Roots, vice-president of the company, furnished the writer with the figures given below.

CUPOLA REPORT.

CONNERSVILLE, IND., Dec. 28, 1887.

Melting in the P. H. and F. M. Roots Co.'s foundry.

DIMENSIONS OF CUPOLA AND BOILER.

Style of cupola	Truesdale.
Outside diameter	54 inches
Largest inside or melting point dia	28 "
Inside dia. at charging door	34 "
Heights from bottom plate up to bottom of charging door	9 feet.
Style of tuyeres	Truesdale.
Size of tuyeres	2 inches.
Number of tuyeres	54
Height from bottom plate to bottom of tuyere	18 inches.
Size and name of blower:	Root's Positive Blast, No. 4.
Size and length of main blast pipe	75 ft. long, 14 in. dia.
Size and length of branch pipes (two), each	14 ft. long, 10 in. dia.

MODE OF CHARGING CUPOLA.

Fuel used for bed	Coke 350 lbs.
1st charge of iron	Scrap 100 lbs. Pig 300 lbs.
1st charge of fuel	Coke, 40 lbs.
2d charge of iron	Scrap 100 lbs. Pig 300 lbs.

This is continued until the fifth charge, when 30 pounds of coke is used with the same quantity and same proportions of iron as in the previous charges, and this is continued until the end of the heat.

MODE OF WORKING CUPOLA.

Time of starting fire	2 30 o'clock	P. M.
Time of charging first iron	4 00 "	"
Blast put on	4.15 "	"
First appearance of fluid iron	4.21 "	"
First stopped in	4 30 "	"
Bottom dropped	5 30 "	"
Revolutions, or stroke of blower		100
Pressure of blast		7½ oz.
Kind of fuel used		Connellsville coke.
Kind of flux used		Limestone.
Quantity of flux		4 per cent.

TOTALS.

Amount of iron melted	6,400 lbs.
Amount of fuel consumed	840 lbs.
Ratio of fuel to iron used	1 to $7\frac{61}{100}$

Fluidity of melted iron. Hot enough for stove plate.

Mr. Roots says, "This was very small heat for us, as most of our men were away. When our heats are larger we can average 9 to 1. We have melted as high as 11 to 1, but the iron troubles us by not being hot. It is a pleasure to us to give any information in our power through this medium."

AMERICAN MACHINIST

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F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, Fred J. Miller, } Associates.

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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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NEW YORK, MARCH 24, 1888.

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Unwieldy Corporations.

Large stock companies and corporations have some advantages in manufacturing that at first thought would seem to provide for the retirement of small firms and individuals in the same line. But there is one compensating feature as between the large corporation with its numerous heads and arms and the more modest firm of two or three members that often neutralizes the apparent advantages, or, as experience has shown in many instances, leaves the balance in favor of the more unpretending effort. That feature is the unwieldiness—so to speak—of the larger bodies.

It has come to be that prompt methods in everything that pertains to the business of manufacturing and disposing of goods, is, in most branches, essential to success. The smaller firms will, in most instances, make their decisions promptly. There are few to consult, and but little machinery of consultation to be put in motion. And there is less trouble and delay from differences of opinions than when the number is greater. It is soon at work in the line marked out, and necessary changes in plans and variations in methods are promptly made. With the large corporation red tape seems to be necessary to harmony. Directors must be got together to decide, those in authority here and there must be consulted, and there is but small chance for prompt action in emergencies; everything tends to delay action until, if taken at all, it is taken too late for the best results. Minor matters of considerable importance may not be considered at all, because it takes too long a time to get the wheels of consideration started.

In lines of manufacture where there is but little call for change the large corporation is at its best. Abundant capital enables it to take advantage of markets, and some particular course marked out may be followed for years. But in anything pertaining to the machinery business the enterprise not large enough to be in any sense unwieldy is quite able to hold its own against any aggregation of capital likely to be pitted against it. In machinery, changes are always imminent, and competition must be met promptly. And the power to make changes in plans and methods must be so constituted as to be available at once.

Mayor Hewitt and the Apprenticeship Question.

It is a fact that ought to be well understood by any one at all familiar with the present state of affairs in mechanical pursuits, that the apprenticeship system is rapidly declining, and in many trades is almost entirely gone. Unwisely, we think, manufacturers, as a rule, have set themselves against this method of recruiting their supply of skilled workmen.

One of the reasons advanced for this state of affairs—and we have no doubt, in many instances, a potent one—is the modern division of labor; where each workman forms a link in a chain, so to speak, and must, in order to secure the highest efficiency, be kept in one place and at one certain part of the work all the time; an arrangement which is interfered with by apprentices, who must, if anything like justice is done them, be advanced from one part of the work to another.

We have before us at this time an article written for a trade journal, in which the writer, speaking more particularly of the plumbing business, declares that "the old apprentice system has perished; its revival is neither possible nor desirable." He then goes on to show that in New York city, at least, the trade schools have taken the place of apprenticeship. This article is by no means remarkable; it is, in fact, similar in sentiment to ninety-nine one-hundredths of the current newspaper comment on the subject. These are not our sentiments, but it is useless to deny that they are those of a large proportion of the manufacturers of the country. And in England the case is not different. Such thinkers as Huxley are free to declare that the days of apprenticeship to trades have gone by, and that school instruction must be substituted. In fact, in England there is scarcely more than one journal, *The Engineer*, that opposes the prevalent idea that the school system of instruction must supersede apprenticeship if English manufacturing supremacy is to be maintained.

In view of the fact, which we had supposed to be well understood, that a large proportion of the manufacturers of this country oppose apprenticeship, the comments of Mayor Hewitt, of New York, as given by him for publication, upon a letter which he received from a young man seeking employment, are, to say the least, remarkable. The young man in question wrote the mayor that he had applied, without success, to more than fifty employers to receive him as an apprentice, and asked the mayor to secure a place for him where he could receive instruction in some mechanical business.

It is not stated that the young man mentioned the reason or reasons given by the fifty employers for their refusal to receive him as an apprentice; but the mayor, in his reply to him, apparently assumes that the sole reason was that the trades unions prevent, by their rules, the employment of apprentices in anything like an adequate number, and upon this assumption takes the opportunity to criticize trades unions, and practically charges them with the responsibility for the fact that so many of our young men are growing up into "habits of idleness, resulting in vice and crime," and pointing out that such action results only in preventing American youths from entering the mechanical pursuits, at the same time allowing foreign workmen to come here and enter the trades.

It is true that trades unions have endeavored to, in some degree, restrict the number of apprentices in different trades, but never to the extent that Mayor Hewitt appears to believe. Whether or not this is wise, is not at present worth much consideration. It will be time enough to consider this question when employers are anxious for apprentices. Just now there is no anxiety in this direction, that we are able to discover, except it may be in isolated instances, and these so rare as not to affect the general question, especially when the unwisdom of apprenticing all the boys to one or two trades is considered.

We venture the opinion that if Mayor Hewitt, before so severely criticizing trades unions, which he so recently declared a necessity of the times, had informed himself upon each of the fifty applications which the young man in question made, he would have found, unless the efforts to secure employment were all in one or two directions, that in not one instance in ten, if one in fifty, was he refused because of any action or rules of trades unions. We believe the mayor's impulses, in this instance, have got the best of his judgment, and led him into unjust, though perhaps popular, declamation. We have received not one, but hundreds of letters from young men who could not find opportunities to learn trades. In not a single instance has the reason been due to any action of trades unions, but rather to the fact that manufacturers do not want, as they generally put it, "to be bothered with apprentices." We earnestly hope, and have faith to believe, that this reason will not always prevail. Mayor Hewitt could do a good work in using his persuasive pen in the direction of inducing manufacturers to give more American boys opportunities to learn trades.

The United States Government has been asking tenders for large lathes to be used in the manufacture of heavy guns. The prices submitted show that there must be a good deal of difference of opinion amongst tool builders as to what is required for this work. Each builder submitted his own plans and specifications, and the prices asked appear to have varied in some instances as much as 100 per cent. It is probable that the prices were honestly given, and that in the main the difference was mainly due to the different ideas of what the tool ought to be. As there is not much room for complication of detail in such tools, the wide variation in the matter of cost must be largely due to a different view as to the proper weight, and this comes perhaps naturally enough when it is considered that the work is of a character and magnitude never attempted in this country before. Doubtless in the next twenty years a good deal will have been learned about making large guns, including the best kind of tools to be used.

One of the most noticeable features of the present time is the movement in the direction of the formation of societies and associations of mechanics for educational purposes. And the best of this movement is that it is as wise as it is noticeable. Any amount of surplus energy can be expended to good advantage in this direction.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(145) L. H., Boston, Mass., writes: Please inform me of any solution you may know for darkening sheet copper, and what it is composed of. *A.*—Copper may be darkened by washing its surface with sulphuretted alkali (sulphuret of ammonia). The solution should be dilute, and after its application the metal should be dried at a gentle heat, and may then be polished with a hard hair brush; or dissolve 5 drachms nitrate of iron in 1 pint of water, and immerse the copper, or 5 drachms perchloride of iron in 1 pint of water will answer the same purpose.

(146) Reader, ——, writes: We have a large quantity of malleable iron nuts to tap that have been japanned. We have tried oil, but it is too hard to get off again. We have also tried soap and soda water, and it rusts the thread. Will you kindly tell us what will answer the purpose? *A.*—We know of nothing better than soda water for the purpose if you cannot use oil. If enough sal-soda is put into it, it will not rust, but will, upon evaporation, leave a white deposit of soda. We should think the oil could be removed by putting them into boiling water containing sal-soda.

(147) J. F. C., Ripley, Ohio, writes: 1. I have a boiler one foot diameter and 2 feet high, with 25 or 30, 1 inch tubes; fire-box one foot square and 6 inches deep. I want to fill in the fire-box with charcoal and run an ¼ inch pipe in and burn coal oil. Can I make steam successfully that way, and will there be much smoke? *A.*—We cannot recommend your plan for making steam. 2. How can I find the area of a circle? *A.*—Consult any elementary arithmetic. 3. How can I make calculations in relation to a safety valve? *A.*—See American Machinist of Dec. 3, 1887, and Dec. 6, 1884.

(148) C. A., Lockland, Ohio, asks: 1. What is the most accurate rule for setting the valves of a Corliss engine? *A.*—See American Machinist of Feb. 27, p. 7. 2. What is the shortest and best way of calculating the horse-power of an engine? *A.*—The only satisfactory way is to use an indicator or a brake. 3. How shall I figure where to put the weight on the lever of a 4-inch safety valve? *A.*—See American Machinist of Dec. 6, 1884. 4. What is the exact measure of piston area, and how is it found? *A.*—The area of a piston is found by calculating the area of a circle equal to the diameter of the cylinder. You can find how to do this from any school arithmetic.

(149) Nemo, Boston, Mass., writes: 1. Will you kindly inform me how to fix india-rubber to iron? I have seen it fixed with shellac prepared somehow to be so tight that you would tear the rubber to sever it. On heating it is easily removed, and you can fasten the same again by heating and applying pressure without fresh cement. *A.*—See answer to Question 425, American Machinist, Oct. 22, 1887. 2. Please inform me of a good book telling how to make an electric motor? *A.*—Among the number of books published on this subject we cannot say which one will suit you best. Write to any publisher for a catalogue, and make your selection. You will probably need more than one book on this subject.

(150) J. L. B., Arlington Heights, Mass., asks: Will you please inform me how to estimate the size of steam and exhaust ports of a small high pressure engine when the piston speed and steam pressure are known? for instance, 3 inch x 5 inch cylinder, the engine to make 300 revolutions per minute with steam pressure at 70 pounds pressure. *A.*—See American Machinitt, Sept. 5, p. 5, 1885.

According to this paper the size of steam ports for your engine will have to be ⅛ inch x 1¼ inch, the exhaust port may or may not have to be ⅛ inch x 1¼ inch. How to obtain the proper width of exhaust port is explained in the paper mentioned.

(151) **Several correspondents who ask** about the expansion of different metals will be able to work out their problems for themselves by consulting the AMERICAN MACHINIST of April 30, 1887. We cannot tell how many horse-power the largest stationary engine will develop.

(152) **S. C. M., Hollidaysburg, Pa., asks:** Why cannot natural gas as it flows from the wells under pressure be used in the cylinder of an engine? *A.*—It has been so used. See AMERICAN MACHINIST of June 7, 1884. One objection to its use is that it contains grit that cuts the cylinder out.

(153) **Carel Freres, Gand, Belgium, asks:** 1. What is the best and simplest method of oxidating pieces of cast or wrought-iron or steel? *A.*—We do not know of anything better than the Bower-Barff process. 2. Of what material are the crucibles made for melting lead in which to heat steel for tempering? *A.*—Cast-iron, generally.

(154) **C. G. S., Italy, writes:** In your issue of Dec. 24, 1887, p. 3, you mention "the master mechanic's allowance for shrinkage of tires," adopted June, 1886. Will you kindly inform me if these have been published in your paper, if not, where can I obtain a list of shrinkage allowance? *A.*—They were published in our issue of January 21, 1888. You may also find them in the yearly report of the Railway Master Mechanics' Association, 1886.

(155) **J. L. B., Arlington Heights, Mass.,** writes: Please advise me what rule is used in estimating the size pipe for steam heating, taking into consideration the heat of the room, and the external temperature. *A.*—Positive rules for determining the size of pipe for steam heating purposes cannot be given. For obtaining the required amount of heating surface, see AMERICAN MACHINIST, Question 279, June 25; and Question 434, Oct. 29, 1887.

(156) **F. A. M., Orange, Mass., asks:** 1. How much steam pressure will a cast-iron box hold with safety 11 inches long, 8 inches wide, 2¼ inches deep; each one of the four corners is rounded with 1¼ inch radius. Metal ¾ of an inch thick? *A.*—It should stand about 20 pounds per square inch. 2. How small a steam gauge is made that is reliable, and how much will it cost? *A.*—Write to any steam gauge manufacturer for a catalogue and price list. 3. Where should a tool rest be placed for a grindstone, above or below the center? *A.*—Above the center.

(157) **J. G. T., Corvallis, Oregon, asks:** 1. What class of steel is mostly used in the construction of boilers? Is Bessemer steel used for boilers? *A.*—We do not know of any boilers made of Bessemer steel in this country. Open hearth steel is generally used. In Europe Bessemer steel is used to some extent for boilers. 2. What is the objection to Bessemer steel for boilers? *A.*—American Bessemer steel is not as uniform, and not as ductile as open hearth steel. 3. Can a boiler be constructed of Bessemer steel as cheaply as of No. 1 iron? *A.*—O. H. boiler plate is about the same price as best flange iron; good Bessemer plate could not be much cheaper if of equal purity.

(158) **C. T. M., Bloomfield, Ont., asks:** 1. Which is the best technical school or university for a stationary engineer to attend in order to thoroughly understand the business? *A.*—We do not know of a technical school in which is taught the business of running stationary engines. We believe there are none. 2. To whom should I apply for an examination for a stationary engineer's certificate? *A.*—The laws and regulations for obtaining a stationary engineer's certificate are not the same in the different States or localities. In some places stationary engineers do not require a certificate. Where a certificate is required, application must generally be made at the police department.

(159) **J. H., Cleveland, Ohio, asks:** Is there any device manufactured or patented that will force the exhaust steam from a steam engine back into the boiler, or is there anything that will completely condense the exhaust steam from an engine? *A.*—There is no trouble in forcing exhaust steam back into the boiler, provided another engine and boiler is used to furnish the power; but it would be a costly operation. Several have tried to do this economically, but we have not heard of success in that direction. We believe there are some patents covering such a scheme, but cannot refer you to them. Any good condenser will condense all the steam from a steam engine. You can find a good many condensing engines at work about Cleveland, and can see how it is done.

(160) **J. A. C., ———, asks:** 1. How do you find the diameter of the circle which the Greenwood planer chuck will plane when the horizontal beam is set at an angle of 5° with the platen? *A.*—By "horizontal beam" we presume the guide bar is meant. To find the radius of the circle planed, divide the length of the chuck, *i. e.*, the distance from the center of the pivots upon which it swings, to the center of the guide pivot, by twice the sine of the angle at which the guide bar is set. This result, multiplied by 2, gives the diameter. Example: The sine of 5° = .08716 × 2 = .17432. Taking the length of the chuck at 16¼ inches, then 16.25 ÷ .17432 = 93.219 = radius of circle in inches. 2. I have seen trap-seals in plumbing work, without vent in top of seal. What prevents siphoning action in a seal of this kind? Is it because the seal pipe is larger than the inflow pipe, thereby avoiding a siphon? *A.*—Whether the seal pipe were larger than the inflow pipe or not, the lower bend of the seal would always remain nearly full of water, because as soon as it was siphoned off sufficiently to let a small quantity of air above the water at this point the siphoning action would be destroyed. After this takes place it is supposed that there will be enough water in the wet pipe and bowl to draw down and seal it again. That is the principle upon which the kind of traps you speak of are supposed to act. It is not considered a reliable action, though, and such seals are not allowed by the health authorities in most of the large cities.

(161) **W. J. F., New York City, writes:** Please give me a rule for calculating the horse-power applied to a journal testing machine. The spindle is carried on two end bearings; between these I place journal to be tested. The spindle turns at a speed of 1,000 revolutions per minute, and I apply a direct pressure of 100 pounds to the journal to be tested, which is 1 inch diameter and 3 inch long. What horse-power is that equal to, and what is the pressure per square inch when the spindle is revolving? *A.*—The pressure per square inch on a journal is usually computed as equal to the total pressure divided by the projected area of the journal in inches. In this case according to the rule it would be

$$\frac{100}{1 \times 3} = 33\tfrac{1}{3}$$

pounds per square inch. In order to determine the horse-power necessary to overcome the friction of such a journal it is necessary to know the co-efficient of friction for that journal at the given speed, and under the given conditions as to lubrication, etc. The formula would be

$$H.\ P. = \frac{p\,f\,v}{33{,}000}$$

Where p = total pressure on journal.
f = co-efficient of friction.
v = velocity of rubbing surfaces in feet per minute.

Assuming the co-efficient of friction in this case to be .05, we have 100 × .05 × 261.8 = 1309 ÷ 33,000 = .039+ = horse-power. The factor 261.8 is the speed of the surface of the journal in feet per minute. If the total power required to drive the shaft is wanted, then the power required to overcome the friction of the other two journals must be added, remembering that their co-efficient of friction may be different, and that the total weight on them will be 100 pounds plus the weight of the spindle and its appendages, modified by the tension of the belt which does the driving.

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W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches: working drawings for the transmission of power by steam, water, air and electricity

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding; if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co, 96 Fulton street, New York.

MANUFACTURES.

T. M. Neal will build a flour mill at Prescott, Ark.

W. S. Kufer will build an ice factory at Thomasville, Ga.

The Ellen Ross Iron Works, Avondale, Ala., are being enlarged.

Wallis & Conly propose to build a sash and blind factory at Jasper, Ala.

The Calera spoke and handle factory expect to move to Anniston, Ala.

A chair factory will be built at Rome, Ga., by B. S. Gibbons and others.

The Irondale Furniture Company will build a factory at Irondale, Ala.

Knights of Labor propose building a bucket factory at Fayetteville, N. C.

The Mobile and Ohio Railroad Company will build shops at Meridian, Miss.

Gordon & Ostrander will build a machine shop and foundry at Lewiston, Ill

The Tuscaloosa (Ala.) Coal, Iron and Land Company will build repair shops.

The Union Furniture Company will build a sash and door factory at Decatur, Ala.

The sum of $10,000 has been subscribed towards building water-works at Batesville, Ark.

The Decatur (Ala.) Iron Company, has been incorporated, with a capital of $200,000.

J. C. Bates is one of the interested parties who will build a foundry and machine shop at Paris, Tex.

The Alabama Great Southern Railroad have begun the erection of repair shops at Birmingham, Ala.

The saw and grist mill of Appleman Bros., recently destroyed by fire at Chatham, Ky., will be rebuilt at once.

The Wainwright Manufacturing Company, Boston, Mass., issue a circular describing and illustrating feed-water heaters of various forms made by them.

The McLeod Railroad Air Signal Company will remove its works from Boston to Canton, Ohio. They receive a large donation in money and 7 acres of land.

The Kansas City (Mo.) Heat, Power and Light Company has filed articles of incorporation. It proposes to establish plants for distributing heat, light and power.

The Eames Vacuum Brake Company has appointed Royal C. Vilas second vice-president of the company, with headquarters at Boreel building, 115 Broadway.

E. & F. N. Spon, 35 Murray street, New York, have issued a supplementary catalogue of new books, published by them. It will be found of interest to those interested in scientific and mechanical pursuits.

The Pittsburgh Tube Works some time since proposed a reduction of the wages of their workmen, amounting to 10 to 15 per cent. The men objected, and the matter was submitted to arbitration. The decision is in favor of the men.

The Union Iron Works, Chattanooga, Tenn., are erecting a large addition to their boiler shops on Cowart street. The framework of a building which will double their capacity has been erected, and will be enclosed during the present week.

Vanderburgh, Wells & Co., pattern and brand letters, etc., recently burned out at Dutch and Fulton streets, New York, have removed to 56 Beekman street. This company—an old one in the business—have a large factory at Paterson, N. J.

Mansfield & Co., Pittsburgh, Pa., recently made a brass casting for the Morgan Engineering Company, that required the melting of 6,000 pounds of metal. It is said to be the largest brass casting ever made in Pittsburgh. Natural gas was used for fuel in melting.

The citizens of Irondale, Ala., have organized a company to build a furniture factory at an early day, and would like to correspond with some experienced person who has some capital and would be likely to want stock in the company. T. S. McDaniel is secretary.

The Laidlaw & Dunn Co., of Cincinnati, Ohio, have been awarded the contract to supply two 7 ft. x 28 ft. Galloway boilers (300 horse-power each) and the pumps to supply same for the electric lighting department in Washington Park at the coming Cincinnati centennial exposition.

The *Tradesman* says: There can be a paying industry easily worked up [at Bellbuckle, Tenn.] by a small investment, say $8,000 or $10,000, by manufacturing the Patent Bellbuckle Reversible Double Shovel Plow. It has a great boom wherever used as a universal cultivator. Can be used for all kinds of cultivation.

Ground has been broken for a new factory for the Damon Paper Box Company, at Auburn, Maine. The factory will be a heavily built substantial structure, two and a half stories in height, with a wing. The main building will be one hundred feet long and forty feet wide. The wing will be twenty feet by forty.

Norwalk's (Ohio) water-works supply, which has been inadequate and unsatisfactory, is to be improved. The city council has passed an ordinance submitting to a vote of the people, at the April election, a proposition to issue $50,000 water-works bonds. This amount will place the works and supply in splendid condition.

The Babcock & Wilcox Company placed, from January 1 to March 5, orders for between 6,000 and 7,000 horse-power of water tube boilers Many of the boilers included in these orders went to foreign countries—England, Germany, France, Scotland, Japan, Wales, Brazil, Ceylon, New Zealand, Spain, Cuba and India being included. In some instances the orders were the 14th and 15th from the same houses.

The United States Government are in want of a large tandem compound engine for the Norfolk Navy Yard, and have asked for specifications from the different builders of such engines in the country. The plans and specifications furnished by the Hewes & Phillips Iron Works, Newark, N. J., have been accepted by the Government engineers, and the bids made must be in accordance with the specifications and plans made by that firm.

A special to the *Tribune* says: The owners of the twelve steel rail mills in the United States are conferring as to how the output for this year shall be distributed. It is estimated that the demand will be just half what it was in 1887, and that prices will be lower. These conferences may result in a revival of the combination which was formed at Atlantic City two years ago, which resulted in an advance of prices when it was least expected by the railroad managers.

The Page Belting Company, Concord, N. H., have issued a handsome and very complete catalogue of belting, lace leather. This catalogue not only describes the different grades of goods they manufacture, but also the kinds and grades of belting best adapted to different kinds of work. It gives information of value to those using belting, and can be had free on application. This company use a machine, the invention of Geo. F. Page, the president of the company, for stretching the belts they make. In this machine the belting from the rolls is passed over and under a series of drums (being passed several times through the machine) and is stretched, by passing over large pulleys or drums, by traction, the same as it would be stretched in actual use. This is in addition to the stretching it receives in manufacture.

Machinists' Supplies and Iron.

New York, March 8, 1888.

Iron—American Pig—The condition of the market shows some improvement since our last report, there being slightly more inquiry for near delivery. We quote Standard Lehigh brands $21 to $21.50 for No. 1 X Foundry, with outside brands at $20 to $20.50. No. 2 Foundry is quoted $19 to $19.50 for Standard Lehigh brands, others at $18 to $18.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 1.

Wanted—A1 machinist who can do good work at moulding. O. E. Hughes, Aberdeen, Dak.

Wanted—A draftsman of experience. Address Ames Iron Works, 38 Cortlandt st., N. Y. City.

An experienced mechanical draftsman wants position. Address T-n, Box 454, St. Paul, Minn.

Wanted—At once, ½ dozen machinists; good pay; steady work. Clark Bros., Belmont, N. Y.

Situation wanted by draftsman; college graduate and 2 years practical exp. A. O. W., Am. Machinist.

Wanted—Foreman for boiler shop in a Western city; give age, experience and reference. F., Am. Machinist.

Situation wanted by a first-class pattern maker with good knowledge of looms and other textile machinery. Address Textile, Am. Machinist.

Wanted—Experienced milling machine hand, capable of having charge of milling job; state age, exp. and wages. B'port Mach. Tool Wks, Bridgeport, Ct.

Wanted—By engineer of exp. with first-class English and American firms, position as supt.; good draftsman and mechanic. Mechanic, Am. Machinist.

Wanted—By energetic young man, situation as foreman blacksmith; large experience in heavy forgings on stationary and marine work; good references. Blacksmith, Am. Machinist.

Draftsman, fitter, pattern maker, experience managing engine and boiler works, wants responsible situation: 11 years' general experience; specialty, soap making plant. Scoto, Am. Machinist.

Wanted—First-class mechanic, as supt., by a corporation making fine line of builders' hardware; must be a young man and a manager of men; all communications strictly confidential. Address Box 1219, N. Y. City.

Engineer (mechanical) desires appointment; accustomed to charge of large engines and machinery, or to superintend erection of new work; varied experience; English and American references. Address Welsh, Johnston House, Cleveland, O.

Wanted—A thorough machinist that has knowledge of steam machinery, to act as foreman of good manufacturing plant, in a city of 35,000; must take about $2,000 stock; state age and experience; fair salary will be paid. Box 85, Am. Machinist.

Wanted—By practical man, situation as foreman moulder of iron foundry; has had large experience as such in the making of all kinds of machinery castings; understands all branches of the business thoroughly; best references. W. W., Am. Machinist.

Wanted—A foreman for machine shop; one who has had experience in building portable and stationary engines and general repair work; and who can handle men to best advantage. Address, stating expectations as regards to salary, P. O. Box C, Schenectady, N. Y.

Wanted—Brass foundry foreman; a practical man who has had experience in making cored work; must be a good mixer and capable of handling men to advantage in work; will pay the right man the best of wages. Address, stating experience, etc., Brass, Am. Machinist.

Practical man with large experience designing and constructing machines and tools for brass and iron work, good inspector, with method of keeping cost account, experience in buying and selling, desires to engage with other parties; references from present firm. Address B. W. Am. Machinist.

Wanted—At the Can. Loco. Eng. Co., Ld., Kingston, Ontario, foreman pattern maker to take charge of their pattern, joiners and tender erecting shop; must be an experienced pattern maker, accustomed to locomotive work. Address, stating age, exper'nce, reference, and salary required.

Wanted—A position as superintendent or foreman by a young man who is a first-class machinist and tool maker, also a good draftsman, and has had large experience in general machine shop practice; a systematic and economical manager of men; best of reference. S., Am. Machinist.

Wanted—In an interior town, a superintendent for an engine works; must be familiar with all the grades of cheap modern engines and modern methods of producing good work cheaply; a permanent position and good salary to the right man. Address M. A. L., P. O. Box 799, N. Y. City.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none, price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Wanted—Special machinery to build; correspondence invited. Address Drawer F, Shenandoah, Pa.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

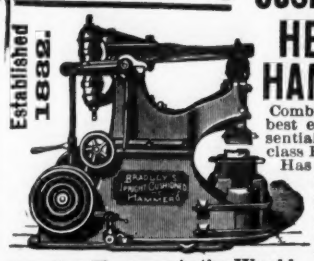
Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Wanted—Shafting lathe 24" to 30" swing, to turn 16' to 20'. Send full particulars and lowest price to Box 241, West Newton, Mass.

30 cents buys a practical pipe wrench for any purpose; Ambler's pipe attachment for monkey wrenches sent by mail upon receipt of price. Agents wanted. A. A. Ambler, Springfield, O.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer. Prepares designs of waterworks pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

Pat. Aug. 30, 1887

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES.

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm hold, quick-working Lever (Not Screw) Vise. Has improved Taper Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to Melvin Stephens.

MACHINE TOOLS

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

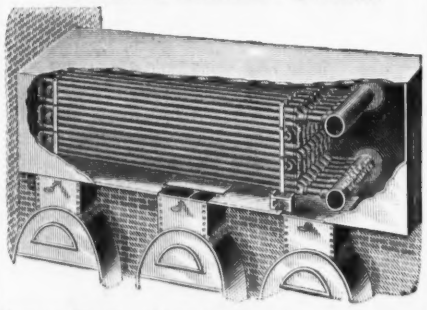
W. ASQUITH, HALIFAX, England.

FOR SALE. Victor Colliau No. 8 Improved Cupola. Having been delivered too late to set up for a special contract, we offer the above very cheap F. O. B. our works.

Dimensions as follows: Height over all, 32 feet. Drum, 84"x8'. Stock, 60"x19', 8". Tap spout, 5' from ground line; bottom of charging door to top of drum, 6', 5"; lines up 46" inside, to run 8 tons per hour.

Todd Pulley & Shafting Works,
East St. Louis, Ill.

THE HUSSEY RE-HEATER
RE-HEATS EXHAUST STEAM.



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Heats Air or Water
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GEO. F. BLAKE MANF'G. CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.

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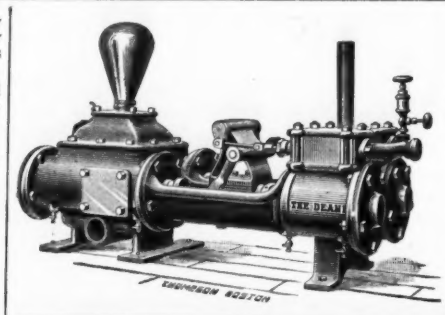

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New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
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15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers, 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

THE HENDEY MACHINE CO.,
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DRILL RODS. The finest stock known for small taps, reamers, punches, jewelers' tools, watch and clock parts, &c. These rods work freely, harden without cracking at low heat, and are exact in size to micrometric measurement.

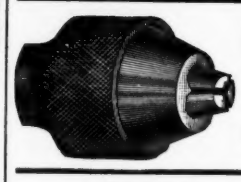
All regular sizes from .013" to 1½" diameter in 12" and 36" lengths. Other sizes to order.

MILLER, METCALF & PARKIN, CRESCENT STEEL WORKS,
CHICAGO, ILL. PITTSBURGH, PA. NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND **LATHES** POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.

OUR NEW 18 in. POWE ENGINE LATHE IS NOW READY



Almond Drill Chuck,
Sold at all Machinists' Supply Stores.
T. R. ALMOND,
83 & 85 Washington St., Brooklyn, N. Y.

BUSINESS OPPORTUNITY.

Having invented a system of electric lighting and the transmission of power by electricity that embraces many new features, I now wish to associate myself with some enterprising party with facilities to put the system on the market. The apparatus has been thoroughly tested and gives an efficiency of 92 per cent. I have 800 lights in operation working by this system which gives perfect satisfaction. Send for particulars. Address W. K. F., care American Machinist, New York.

TANITE EMERY WHEELS and GRINDING MACHINES
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS.
For Circulars address
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A Treatise on the Use of Belting for the Transmission of Power. With numerous illustrations. Third Edition, carefully revised. With Appendix. By John H. Cooper, M.E. 1 vol., demy octavo. **Price, $3.50.**

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Engineers' Handy-Book. The most comprehensive and best illustrated book ever published in this country on the Steam Engine, Stationary, Locomotive and Marine, and the Steam Engine Indicator. **Price, $3.50.**

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Young Engineer's Own Book. Containing an explanation of the Principle and Theories on which the Steam Engine as a Prime Mover is Based. With 106 illustrations, 363 pages. 18mo. **Price, $3.00.**

Any of the above works will be sent to any part of the United States or Canada on receipt of list price. Send Money in Registered Letter, P.O. Order, or Postal Note. Descriptive Catalogues sent to any address, on application to

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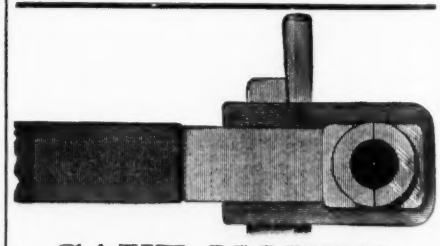
UNLESS SOONER DISPOSED OF, THE ABOVE works will, under the order of the Superior Court of Fulton county, and subject to confirmation by the same, be sold to the highest bidder on WEDNESDAY, the 28th DAY of MARCH, 1888, at 12 o'clock noon upon the premises.

Lot of land, nearly two acres, only 800 yards from center of Atlanta, fronting on Hunter and King streets and the Georgia railroad, with spur tracks directly into the grounds. Largest works in Atlanta, commanding the trade of the entire South! The most complete plant in the South for manufacturing every variety of machinery, including engines, boilers, marble-cutting and gold-mining machinery, with other specialties, the demand for which is daily increasing. Substantial brick buildings with metal roofs. Apply soon for a bargain and easy payments. For full particulars address,

W. H. SMYTH, Receiver.



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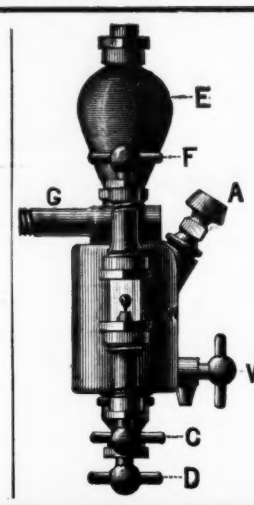

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Price	$10.00	$12.00	$15.00
Capacity	½ pt.	½ pt.	¾ pt.

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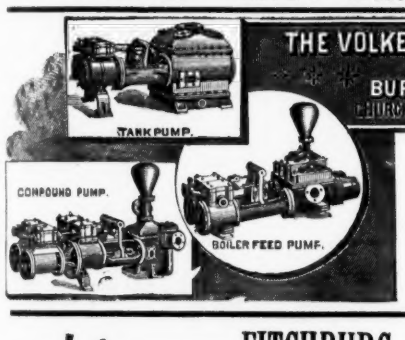

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Slow-speeded, Force-blast. Durable, Compact and Cheap.
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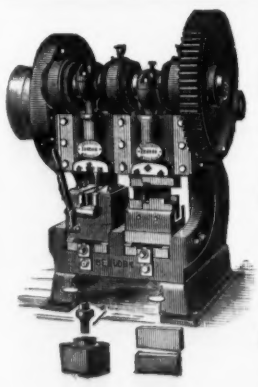

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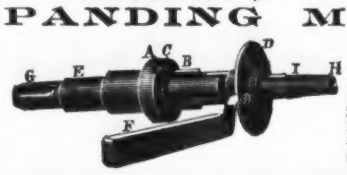

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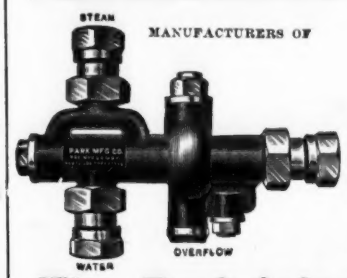

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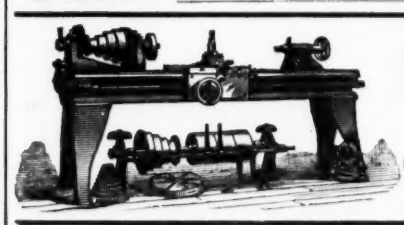

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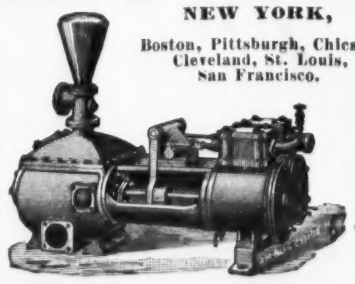

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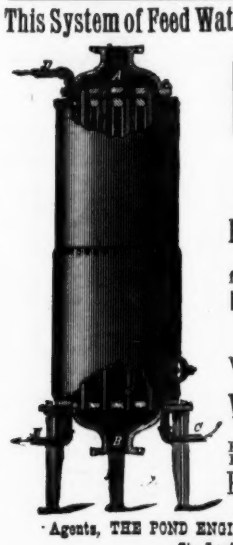

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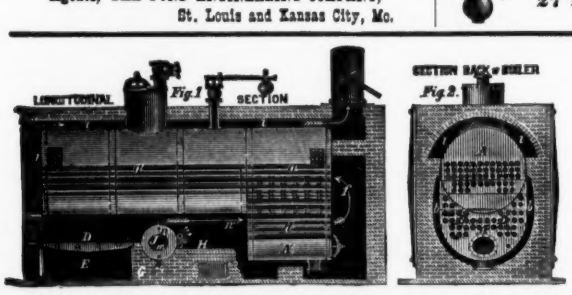

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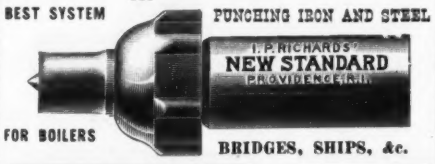

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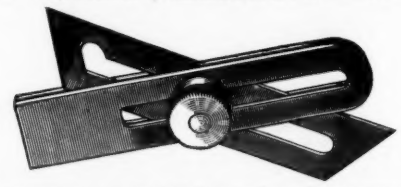

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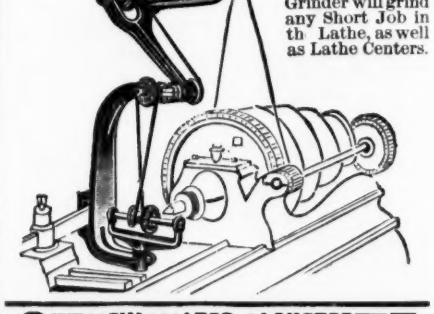

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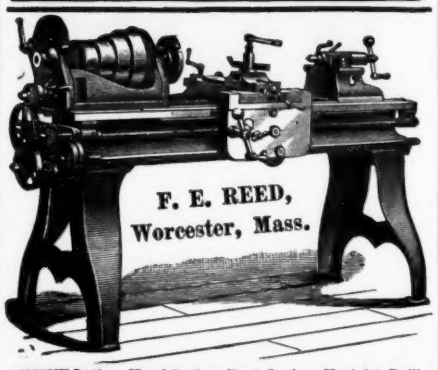

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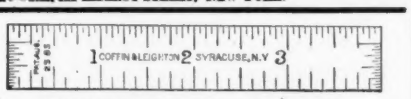

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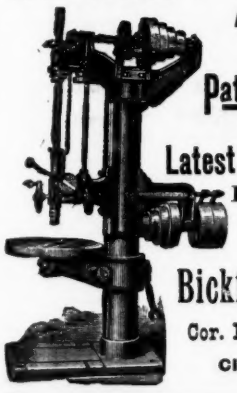

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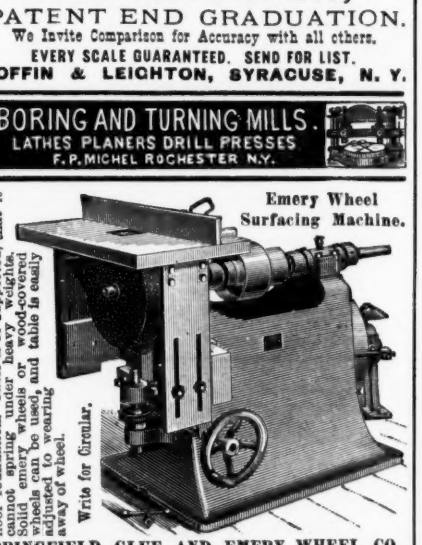

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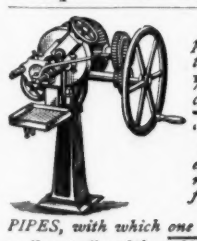

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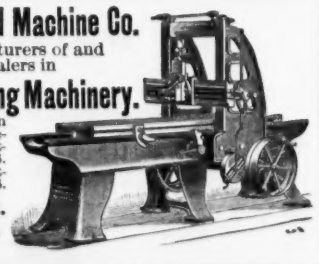

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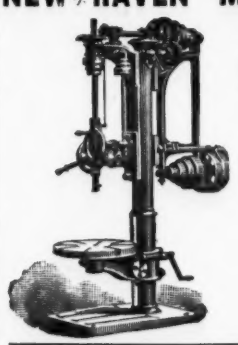

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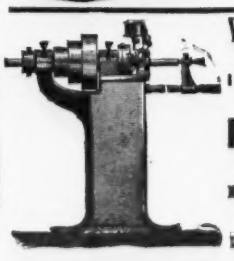

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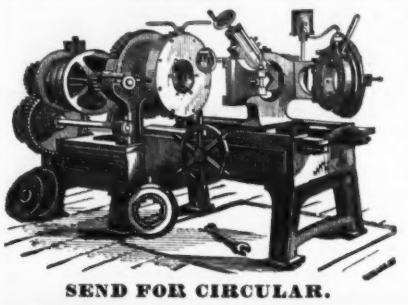

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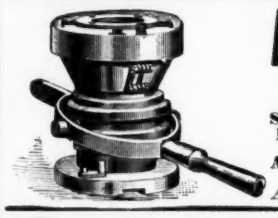

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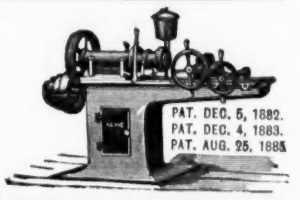

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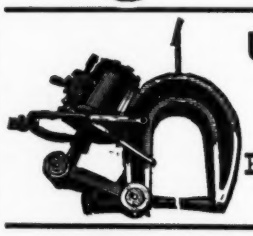

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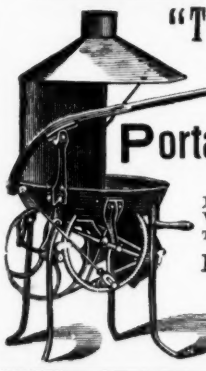

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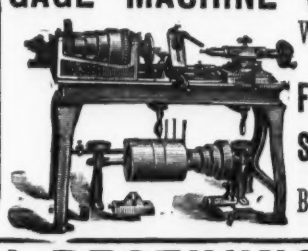

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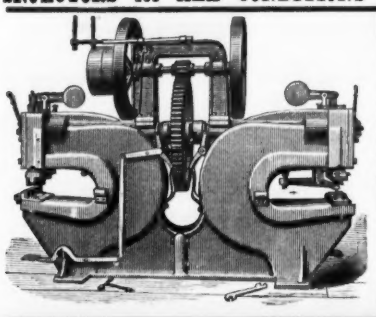

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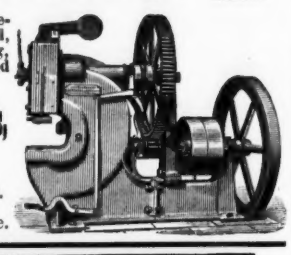

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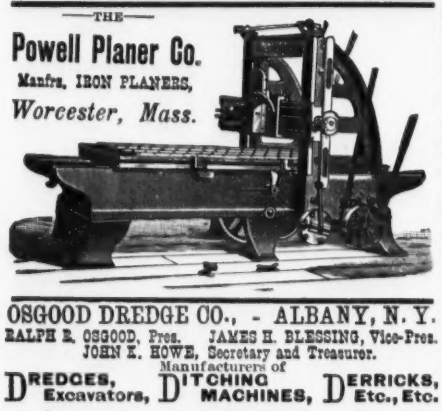

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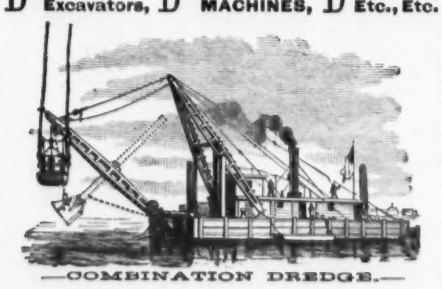

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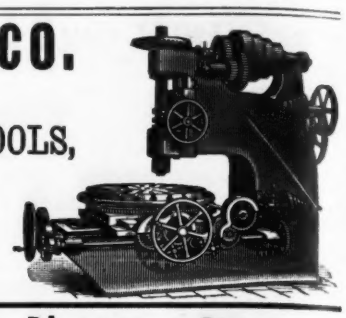

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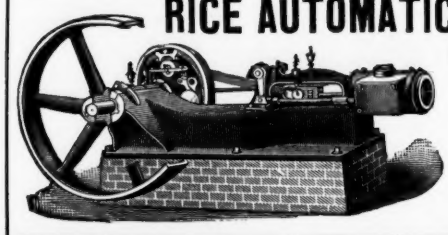

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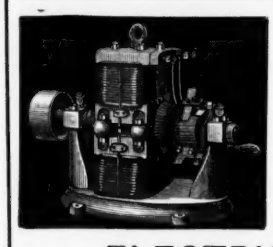

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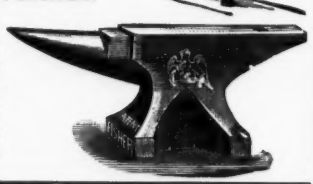

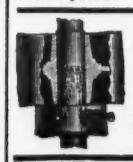

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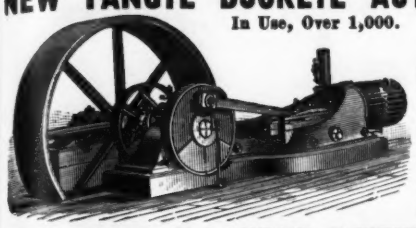

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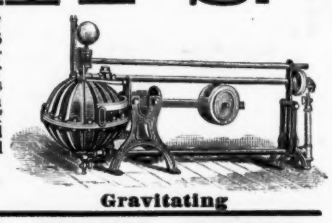

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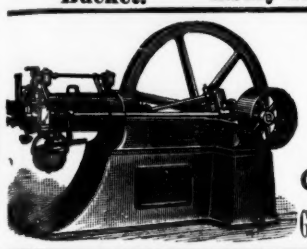

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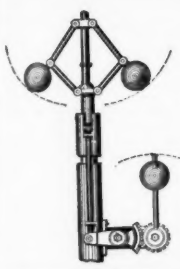

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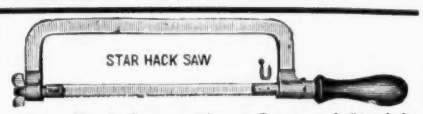

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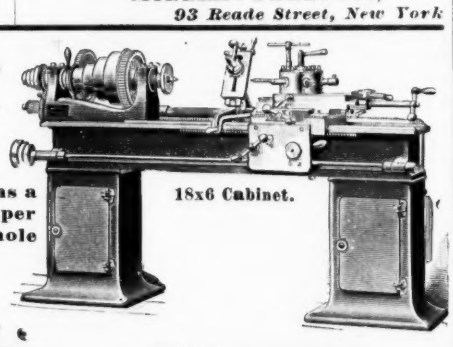

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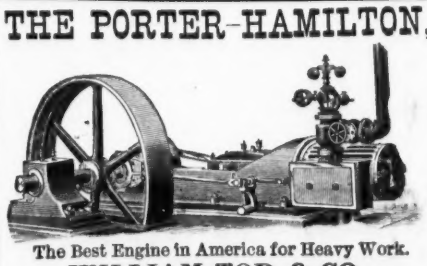

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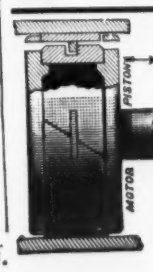

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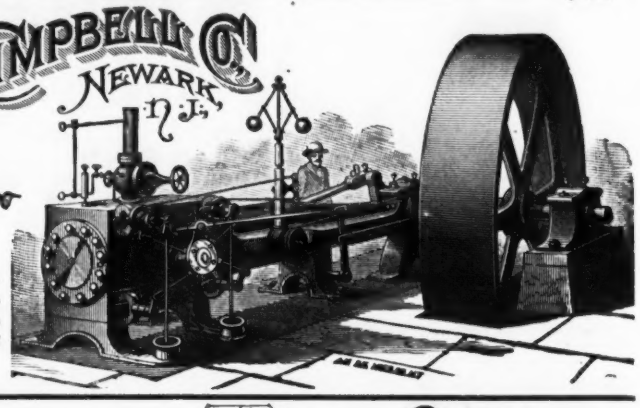

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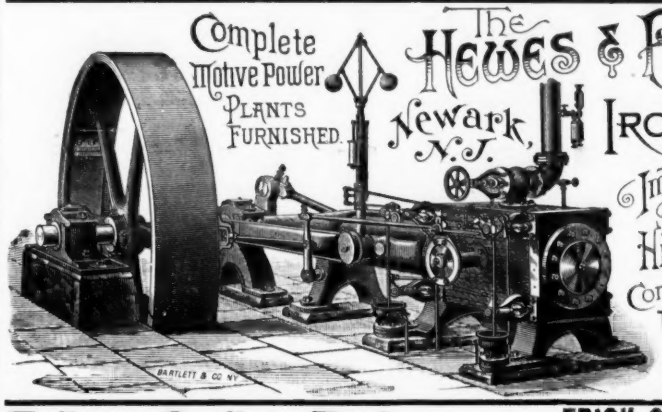

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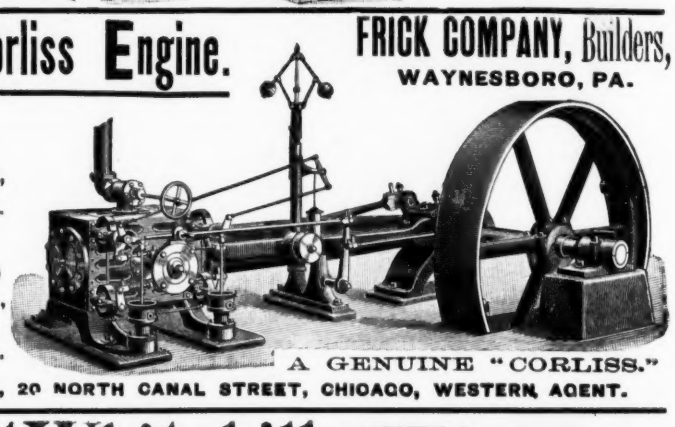

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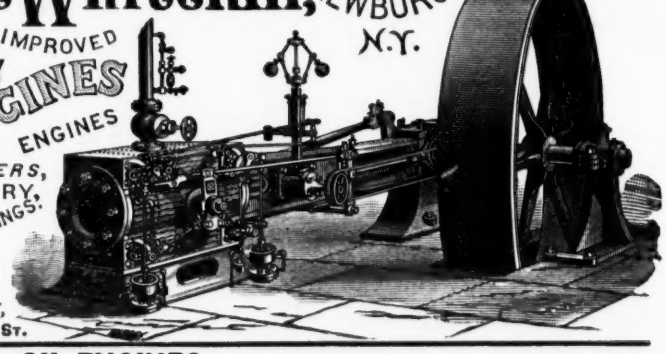

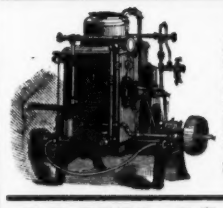

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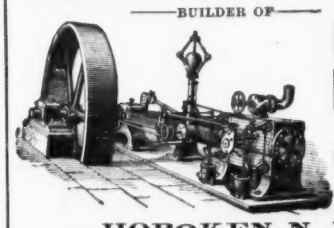

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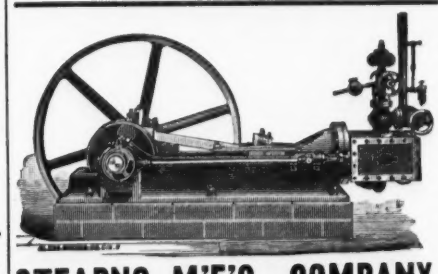

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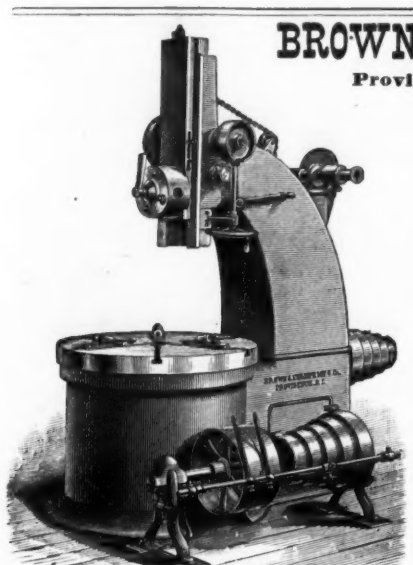

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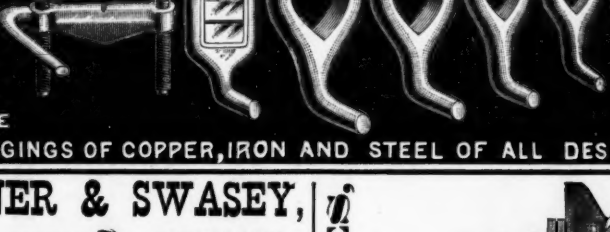

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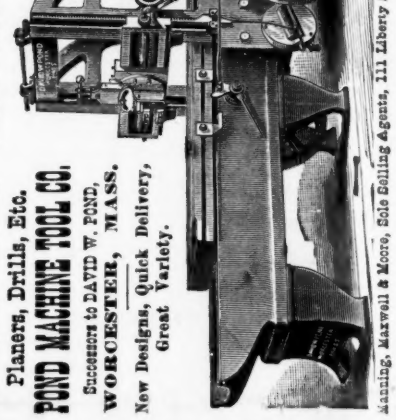

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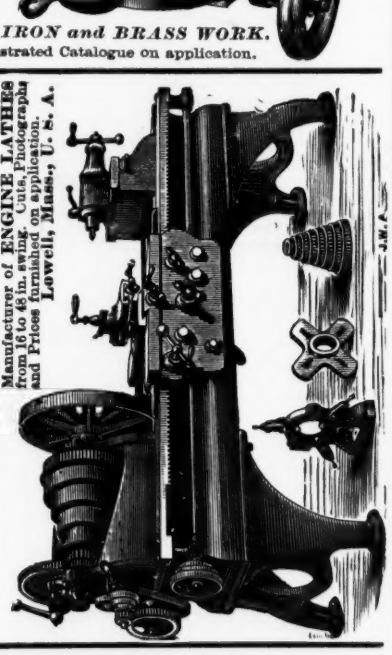

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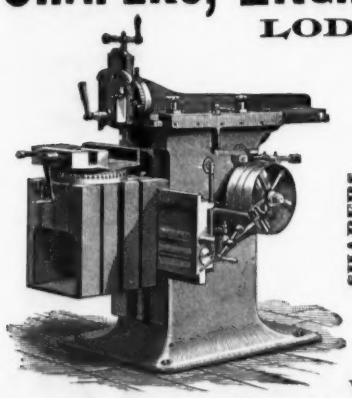

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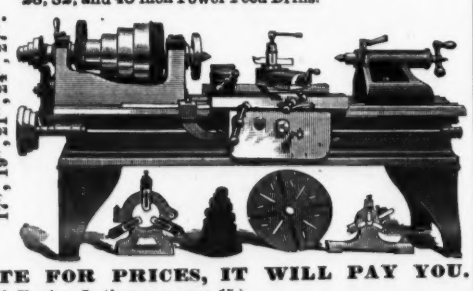

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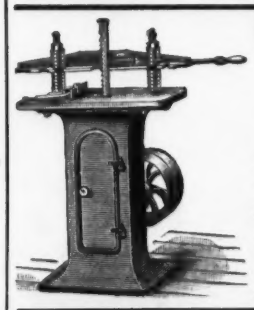

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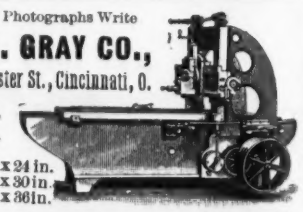

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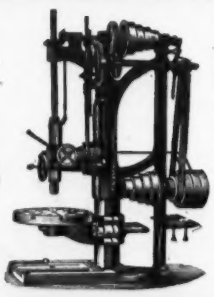

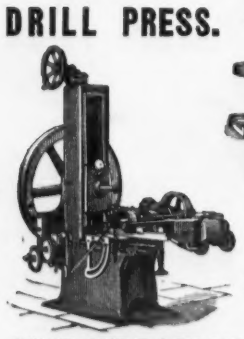

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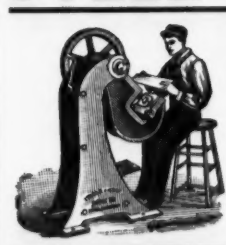

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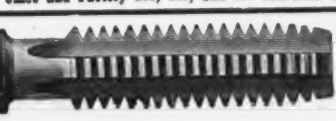

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